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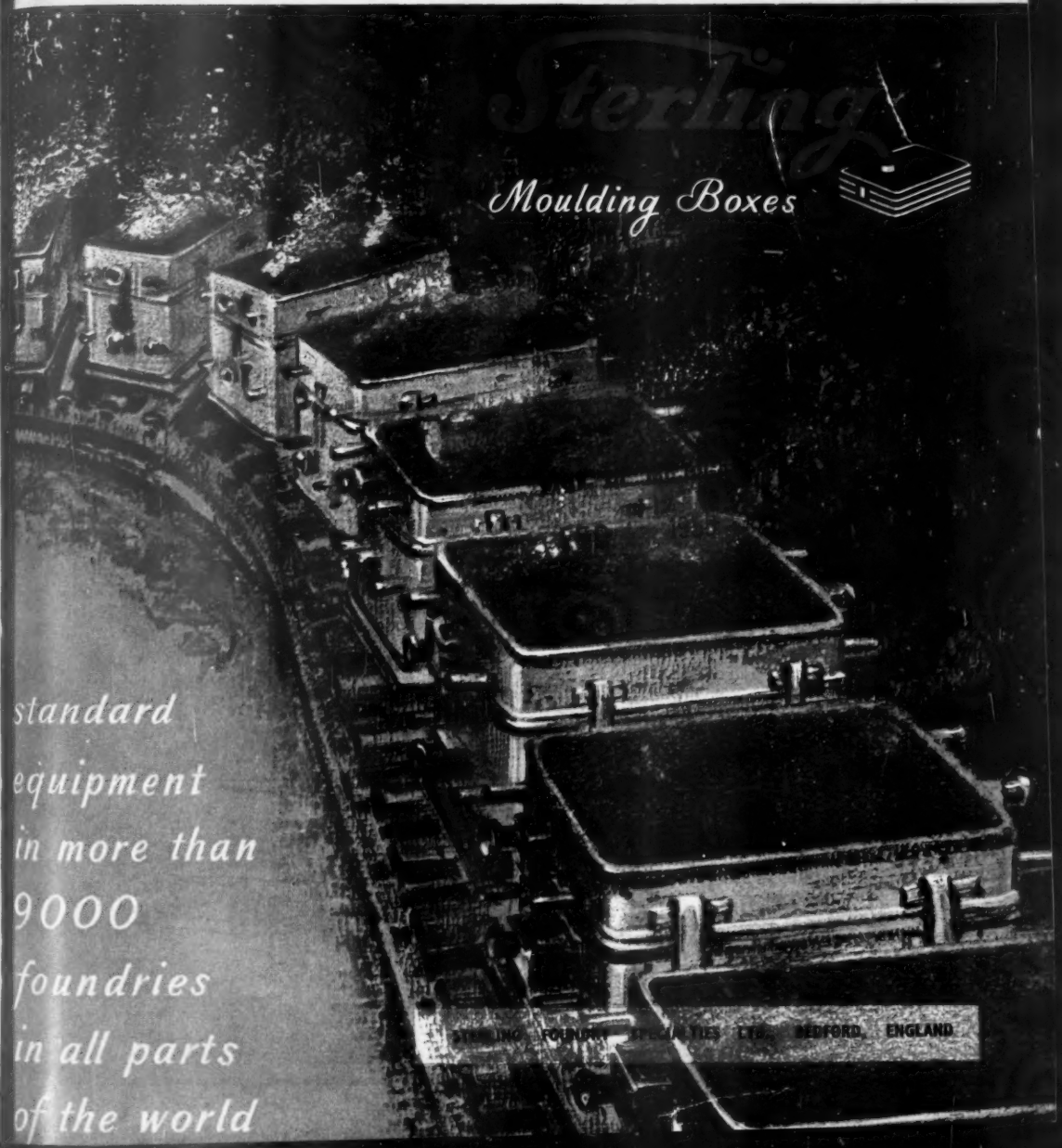

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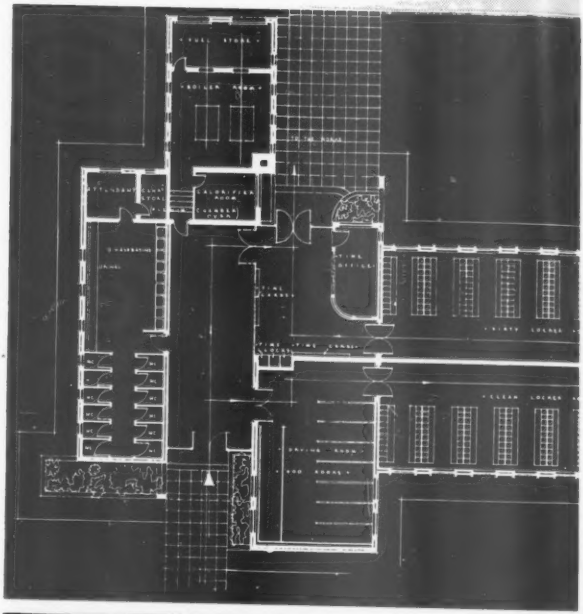

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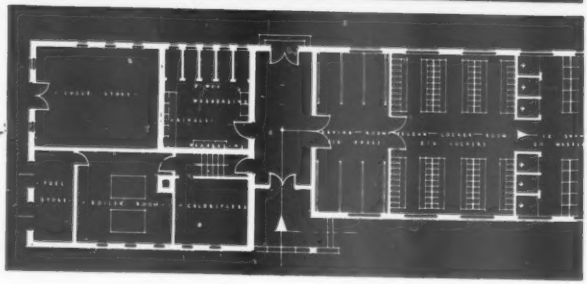

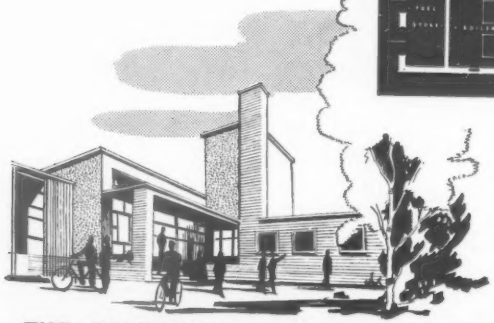

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# Nothing in Between

Ever since the organization of yearly examinations by the City and Guilds of London Institute in Foundry Practice there have been recurring grumbles that the papers set are too theoretical. The latest and most important emanates from a *Bulletin* issued by the Council of Ironfoundry Associations which states (when covering the activities of its Training Committee) that "The first project is to draft a syllabus of training for young foundry workers who are not likely to attain the standards necessary for the completion of the City and Guilds courses in foundrywork. It is considered that a simplified syllabus which omits most of the theoretical content of the City and Guilds syllabus would meet a widespread need in the industry, and would give lads with a practical turn of mind a better chance to develop their latent talent." We have much sympathy with this notion, but little hope of its successful outcome.

Our lack of hope is based on the simple fact that a practically minded boy has to convince an examiner by either writing, drawing or speaking that he is efficient, plus the accepted principle that for the examination to be of any worth, the questions posed must be the same or nearly the same for all. Now, before any steps are taken to institute a fresh or modified examination, the following facts should be realized: (1) The steady growth of candidates taking the City and Guilds examinations in Foundry Practice is noteworthy, the number having risen from 36 in 1942 to 446 in 1954; and (2) The percentage of passes, despite some fluctuations, has been tending to rise. Thus the examinations are becoming increasingly popular and are worthy of increasing support and less criticism.

To evaluate a boy's worth as a craftsman is possible by a craft competition and, indeed, this has been done by Middlesbrough and Sheffield, and is now being carried out in London, by the Institute of British Foundrymen. It is a good, but not perfect, method when effected locally, with provision as to the choice of metal to be cast, and it can cater for the type of work being carried out in the district, except, of course, for the making of very large jobs. Such a test involves no reading, writing or drawing, whilst every other type except oral tests does. Looking at the question in its broadest aspects, it resolves itself into either occupying a seat in a classroom or being given a practical test in the workshop; there is nothing in between—both systems are expensive to carry out, especially the practical craft tests. In the former case the questions are invariably graduated, allowances are made for the boys' general education, and marks are given where the examiner is satisfied that the boy really knows the answer—even though he expresses himself badly. In the latter case there is a large number of variables to control to achieve equity.

## Exposure Calculator

The British Steel Castings Research Association announce that an improved Mark II model of their radiographic exposure calculator has now been produced having scales for use with the isotopes $^{137}$caesium and $^{170}$thulium, in addition to those for $^{60}$cobalt, $^{192}$iridium and radon which appeared on the earlier Mark I version. To meet the demand from continental countries, a Mark III version of the calculator has also been produced, in which metric scales replace the inch scales on the Mark II model.

Scales for the newer isotopes $^{170}$thulium and $^{137}$caesium, have been included primarily to meet the requirements of industries other than steelfounding and of the overseas market. $^{170}$Thulium, with a half-life of 127 days, is an extremely useful source for the examination of sections of steel less than ½-in. thick, or in other cases where low to medium energy radiation is required*. $^{137}$Caesium emits radiation somewhat similar to that from $^{192}$iridium, but its half life of 33 years, as compared with only 10 weeks for iridium, makes it more attractive to overseas users, for whom the return of sources to Harwell for periodic re-irradiation is both expensive and inconvenient.

In addition to the increased versatility of the new calculator, improvements have also been made in the general construction and appearance, and the length and thickness of the rule have been reduced to strictly "pocket size". Further information is available from the British Steel Castings Research Association at Broomgrove Lodge, Sheffield 10. Export enquiries should be addressed to M. Falk & Company, Limited, 5, Victoria Street, London, S.W.1.

* See: "$^{170}$Thulium as a Low Energy Source for Gamma Radiography" by Williamson, Rossiter & Bentley. *Proceedings*, Radioisotope Conference, Oxford, 1954.

## *Correspondence*

### WORKING IN A FOUNDRY AT 80

*To the Editor of the* FOUNDRY TRADE JOURNAL

SIR,—In view of the discussions in the Press recently on the question of raising or lowering the retirement age, we feel that you will be very interested to learn that one of our employees in the foundry has very fixed views on this subject. He is Mr. John Pearce, of 84, Arthur Street, West Bromwich, who is still working full time, and will be 81 years old on his next birthday.

Mr. Pearce has worked in a foundry all his life, including the periods of the two world wars. He commenced work at the age of 12, at which time he tells us that his wage was 4s. per week, the working hours being from 6.30 in the morning until 6.30 at night, Monday till Saturday. For the past eight years he has been employed with this company, but perhaps we should mention that now he only works a "mere" 44-hour week. We must also mention that he is one of the best and regular timekeepers on the firm.

He has three married children and six grandchildren, and he and his wife celebrated their Golden Wedding on Boxing Day—needless to say he was back at work as usual the next day at 7.30 a.m.—Yours, etc.,

W. A. JONES,
Director,
ALUMINIUM PRODUCTS, LIMITED.

Alpro Foundry,
Haines Street,
Spon Lane,
West Bromwich.
January 4, 1955.

## Midlands Industry

Supply of steel and the availability of labour are likely to be the only limiting factors to a continuance through 1955 of the present state of prosperity in Midland industry, it was stated last month, after a meeting of the Midland Regional Board for Industry, in Birmingham. The number of unemployed was the lowest since 1951; short-time working was stated to be at a "phenomenally" low level.

Major C. R. Dibben, chairman of the board, said that the shortage of steel was a problem that had been raised with the Government through the National Production Advisory Council. The Ministry of Supply had promised that every effort would be made to overcome the shortage in the new year by further imports and increased home production. Particularly lacking were steel sheet, strip, tubes and wire. The demand for materials would continue to rise if 1955 was going to be another year as prosperous as 1954, he said. The motor industry had asked its suppliers to increase their output to meet their demand and nationally, about £100,000,000 was to be spent by motor-trade suppliers to increase productivity.

Mr. W. E. Davis, Regional Controller of the Ministry of Labour, stated that the number of registered unemployed in the region in November was 10,471. Since then, provisional figures for December showed further reduction, of about 1,000. Of the total number of unemployed, some 60 per cent. were out of work only for short periods and the real unemployment figure was no higher than 3,000 out of a total employable population of 2,000,000. The number of registered unemployed in the Midland region was 0.5 per cent. compared with 1.2 per cent. for the country as a whole.

## Colin Stewart's Progress

Colin Stewart, Limited, Wharton Hall, Winsford, Cheshire, celebrated the 40th anniversary of their establishment by entertaining their staff to a dinner/dance just before Christmas. The firm was established in 1914 by Mr. R. W. Wilson for the purpose of pulverizing pottery waste. It was and still is known as the "mug works." In 1920, the Foxdale quarries in the Isle of Man were purchased. The management of the firm was taken over by Mr. J. N. Wilson in 1931, and he was appointed managing director in 1941. In 1935, the company became interested in bentonite and have handled increasing tonnages ever since. In 1942, the Coed Talon factory in North Wales was acquired, and in 1947 a factory at Llangollen. The firm now employs about two hundred people, and operates five factories and two quarries. This year it should produce more than 1,000 tons of material per week.

A FINE of £5 with costs was imposed on Isca Foundry Company, Limited, Newport (Mon), by Newport Magistrates for a contravention of the Factories Act, 1937. Mr. T. M. Hoskison, District Inspector of Factories, prosecuting, told the court that a man was at work on a ladder propped up near the wheel track of an overhead travelling crane. The crane touched the ladder in passing and the workman was thrown off. Fortunately he received only a few bruises, but there had been so many serious accidents caused by cranes lately that this case might serve as a warning. For Isca Foundry Company, it was said this was the first accident in 100 years.

# Development of the Lost-wax Process of Precision Casting, 1949-53*

*By J. S. Turnbull*

*The paper describes the limitations of the original lost-wax process* (1945-49) *and improved methods developed in the precision casting shop of the Metropolitan-Vickers Electrical Company, Limited, by which the process has extended its application in industry. In the technique of wax injection, methods are described for eliminating "draw" in wax patterns, and for making accurate patterns considerably larger in size. Wax-injection machines are also described. In the manufacture of moulds, the new "Investment X" technique of shell moulding is described with full details of its technical and economic advantages. Methods of improving progressive solidification in castings are discussed. The application of centrifugal and vacuum casting is discussed. Attention is drawn to the mechanical properties of S.80 castings with higher consistency resulting from a combination of Investment X and centrifugal casting. Distortion of patterns and of castings are described and methods of correction suggested. The economics of lost-wax castings are considered and, finally, the scale of manufacture is reviewed with a view to mechanization.*

## Introduction

The Author's first paper on the subject† was a general description of the lost-wax process of precision casting as practised in Britain at that time. This second paper is concerned with the development of the process in the precision casting shop of the Metropolitan-Vickers Electrical Company, Limited. This "lost-wax" foundry differs in many respects from other foundries. Not only has it to satisfy a demand for large quantities of gas-turbine components, but also to supply, for use in the company's electrical and mechanical products, considerably larger castings of all sizes and complexities, for the production of which the original process was totally unsuited. In the presentation of the paper, it will be found that developments are recorded in order of operational sequence. The word "development" is used in the widest possible sense, covering process simplification, economical manufacture, and the highest standard of metallurgical quality.

A bronze image, believed to be eighteenth century and probably of Burmese or Chinese origin, which was made by the lost-wax process is shown Fig. in 1.

## Manufacture of Wax Patterns

The injection of liquid wax into metal dies has one fundamental difficulty, namely, the avoidance of "sinks" and "draws" due to contraction when the material is passing from the liquid to the solid state. This difficulty can be largely overcome in small patterns by injecting the wax at the lowest possible temperature under high pressures of from 1,500 to 2,000 lb. per sq. in. With larger patterns, however, it is not possible to obtain satisfactory results under conditions of low wax-temperature, and high pressure, since the sectional area of the largest part of the pattern compares unfavourably with the sectional area of the injection sprue. The wax sprue will solidify many seconds before the solidification of the wax patterns and draw will take place, with resulting distortion of the pattern shape. This difficulty can be overcome by using a wax insert suitably located in the die cavity, so as to even out the sectional difference between sprue and pattern; but this introduces the additional complication of insert manufacture with additional tool costs. Further disadvantages of the low-temperature, high-pressure injection are:—

(1) Short life of soft metal dies under the

* Paper presented at a general meeting of the Institution of Mechanical Engineers, arranged in conjunction with the Industrial Administration and Engineering Production Group. The Author is works development engineer, Metropolitan-Vickers Electrical Company, Limited, Manchester.

FIG. 1.—*Lost-wax bronze casting—image of Kwan Yin, an Asiatic goddess, seated on the Asiatic conception of a lion; probably eighteenth century.*
*(Courtesy of Major A. W. Muir)*

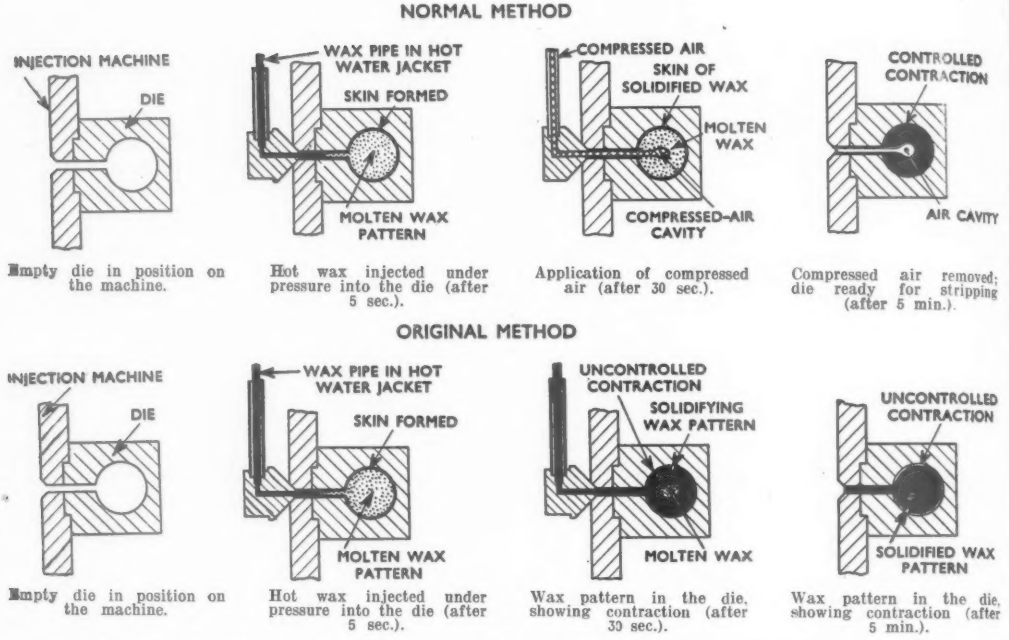

NORMAL METHOD
INJECTION MACHINE
DIE
WAX PIPE IN HOT WATER JACKET
SKIN FORMED
MOLTEN WAX PATTERN
COMPRESSED AIR
SKIN OF SOLIDIFIED WAX
MOLTEN WAX
COMPRESSED-AIR CAVITY
CONTROLLED CONTRACTION
AIR CAVITY
Empty die in position on the machine.
Hot wax injected under pressure into the die (after 5 sec.).
Application of compressed air (after 30 sec.).
Compressed air removed; die ready for stripping (after 5 min.).
ORIGINAL METHOD
INJECTION MACHINE
DIE
WAX PIPE IN HOT WATER JACKET
SKIN FORMED
MOLTEN WAX PATTERN
UNCONTROLLED CONTRACTION
SOLIDIFYING WAX PATTERN
MOLTEN WAX
UNCONTROLLED CONTRACTION
SOLIDIFIED WAX PATTERN
Empty die in position on the machine.
Hot wax injected under pressure into the die (after 5 sec.).
Wax pattern in the die, showing contraction (after 30 sec.).
Wax pattern in the die, showing contraction (after 5 min.).

FIG. 2.—*Sequence of operations on a wax-injection machine, whereby compressed air eliminates shrinkage defects.*

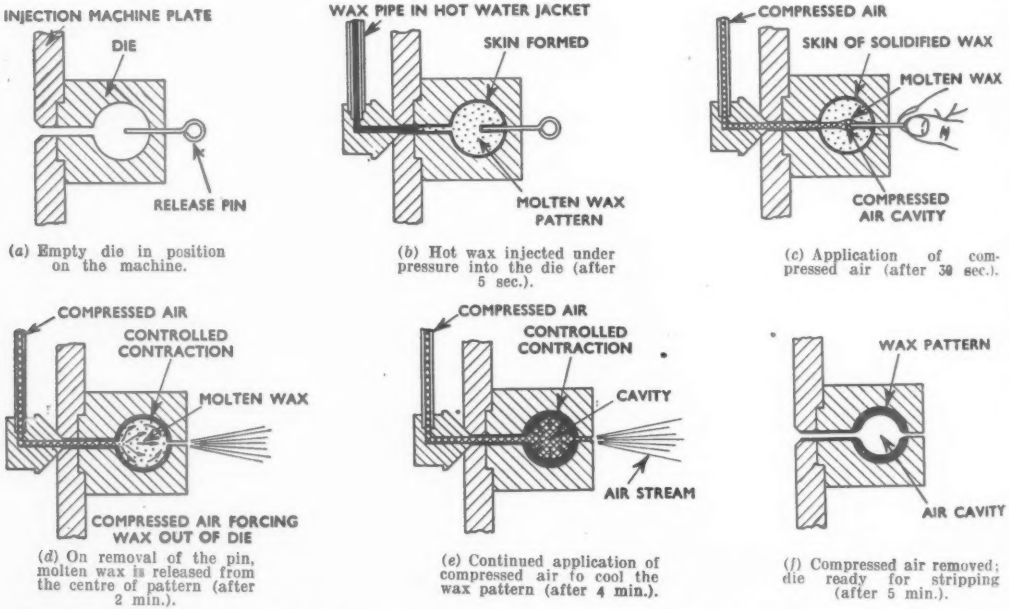

INJECTION MACHINE PLATE
DIE
RELEASE PIN
WAX PIPE IN HOT WATER JACKET
SKIN FORMED
MOLTEN WAX PATTERN
COMPRESSED AIR
SKIN OF SOLIDIFIED WAX
MOLTEN WAX
COMPRESSED AIR CAVITY
(a) Empty die in position on the machine.
(b) Hot wax injected under pressure into the die (after 5 sec.).
(c) Application of compressed air (after 30 sec.).
COMPRESSED AIR
CONTROLLED CONTRACTION
MOLTEN WAX
COMPRESSED AIR FORCING WAX OUT OF DIE
COMPRESSED AIR
CONTROLLED CONTRACTION
CAVITY
AIR STREAM
WAX PATTERN
AIR CAVITY
(d) On removal of the pin, molten wax is released from the centre of pattern (after 2 min.).
(e) Continued application of compressed air to cool the wax pattern (after 4 min.).
(f) Compressed air removed; die ready for stripping (after 5 min.).

FIG. 3.—*Sequence of operations on a wax-injection machine, whereby molten wax is blown out to produce a hollow wax pattern.*

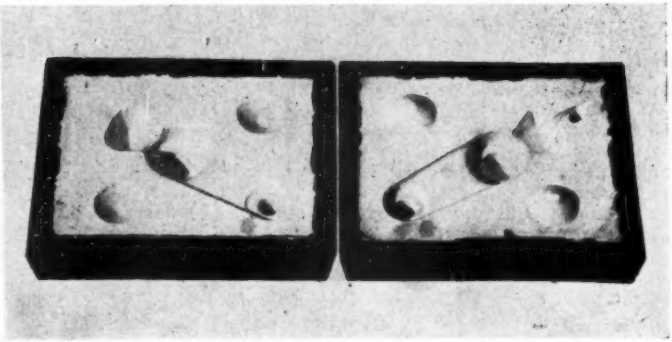


FIG. 4.—*Plaster-of-Paris, wax-injection die.*

stress of high pressure;

(2) Distortion of the wax pattern after it has been ejected from the metal die.

An improved method of making the larger type of wax pattern is as follows:—

(1) Inject wax at a temperature 20 deg. C. above its solidification point at a pressure of 100 lb. per sq. in.;

(2) 30 sec. after injection, remove the wax injector and apply compressed air at 100 lb. per sq. in.;

(3) Allow to solidify, remove compressed air, extract pattern.

This sequence of operations, as shown in Fig. 2, produces a wax model free from draw and shrinkage defects. It is not true to say that contraction will be entirely eliminated, since the pattern is still subject to thermal contraction which takes place after solidification, and which will continue until the wax reaches room temperature.

When the wax pattern is very large, it will be found that the method described above is too slow, owing to the very long time taken by the wax to solidify. It is possible to improve the cooling characteristics of the dies by circulating a coolant at low temperature through the die metal, but this improvement will not solve the difficulty created by the poor thermal conductivity of a large volume of wax. In such instances the following process may be applied:—

(1) Inject wax at a temperature about 20 deg. C. above solidification point and at a pressure of 100 lb. per sq. in.;

(2) 30 sec. after injection remove the wax injector and apply compressed air at 100 lb. per sq. in.;

(3) After a further time interval—30 sec. to 2 min.—remove a pin from opposite end of die. The liquid wax is then blown through the wax pattern, emerging as a form of wax fibre, leaving a shell wax pattern which is quickly cooled by the air circulating through it (Fig. 3).

There is a danger in the use of hollow wax patterns—that the pattern shape may be distorted by the investment operation—this point will become clearer at a later stage in the paper.

### Wax-Injection Dies

One of the main attractions of the lost-wax process is that it can handle both long-run and short-run production orders for relatively cheap die costs. Thus, orders for from one to 50 components can be made by use of simple plaster-of-Paris dies, for a tool cost of £5 (Fig. 4). Orders for from 50 to 15,000 can conveniently be handled with a bismuth/tin die with tool charges of from £20 to £50 (Fig. 5). Long-run orders of 15,000 or above are advisedly carried out with steel dies, with tool charges of from £50 to £120.

### Wax-Injection Machines

Three types of wax-injection machines are in operation:—

(1*a*) Universal machine which can inject patterns of all sizes and shapes. This machine is designed to inject wax into the die box at the lowest point, thereby forcing the air to rise upwards and escape through the die parting line. To enable easy working of this system, the machine is hinged on trunnions. The wax is injected with the die vertical and the wax pattern is removed with the die horizontal. Fig. 6 shows the cycle of operations.

(1*b*) Universal machine, working on same principle as (1*a*), which can inject six dies simultaneously. Fig. 7 shows the grouping of compressor-blade dies on the main die plates. Fig. 8 shows the wax being injected into the master valve which also admits the compressed air and ejects the runner bar.

(2) Semi-automatic machine as shown in Fig. 9. The wax is injected through the die parting-line,

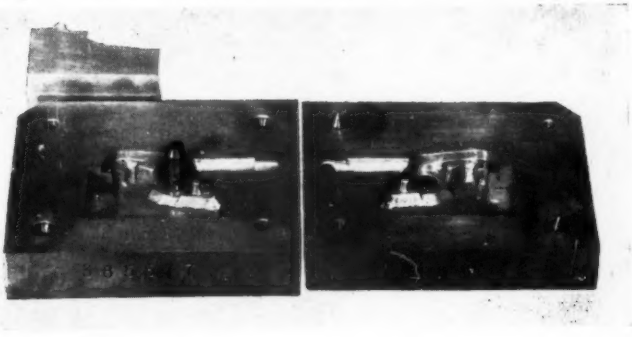


FIG. 5.—*Bismuth/tin wax-injection die.*

*Development of the Lost-wax Process*

the die halves being parted hydraulically. The pattern is removed by ejector pins operating through the stationary half-die. Fig. 10 shows the wax pattern being ejected.

(3) Vacuum injection machine, a specialized machine for use with complicated dies. The die is cleaned, coated with parting medium, and located on die platen. The platen is then raised pneumatically until the die is clamped in position. A metal cover is raised pneumatically by two ancillary pressure cylinders, vacuum sealing on a rubber gasket. The system is evacuated and wax under pressure is introduced through a slide valve on the top plate. Compressed air to eliminate contraction draw is unnecessary on this machine, owing to vacuum pressure on the outer faces of the wax pattern. Excellent surface finish is obtainable, cycle times are longer than for universal machines. Fig. 11 shows a rotor wax-pattern die in operation producing a wax model as shown in Fig. 26.

### Principles of Operation

The principles of operation are as under:—

(1) All dies are fed with wax at the lowest point, to assist in removal of the air, and to eliminate turbulence;

(2) All dies are injected with the parting line in the vertical plane, to facilitate the removal of air;

(3) All dies are lubricated with ethyl silicate or other non-sticking parting media, to facilitate removal of wax patterns;

(4) Where air locks do occur, the die is vented on the parting face;

(5) Conical locating pins are used for correct die register;

(6) Steel back-plates are affixed to soft metal dies to avoid distortion when clamping;

(7) Injection hole is $\frac{1}{4}$ in. or less in diameter, according to size of wax pattern;

(8) After extraction of the wax pattern from the die, all traces of ethyl silicate are carefully removed.

Principles of (1) (2), and (4) do not apply to the vacuum-injection machine.

### Design of Assembly of Wax Patterns

The method by which the casting is done will decide the wax-pattern assembly. Two main methods of casting are used:—(1) Centrifugal casting and (2) gravity casting. As might be expected, the weight ratio of runner to component part is considerably lower for centrifugal castings than for gravity castings. The following approximations are given: gravity-cast components, 30 to 50 per cent. of metal poured; centrifugally cast components, 50 to 60 per cent. of metal poured.

After the type of wax assembly has been decided, the next step is to plan the wax assembly on the basis of a total wax weight of 2 lb. This calculation is made on a casting weight of 15 lb. of metal; the ratio of metal weight to wax weight is $7\frac{1}{2}$.

The wax patterns can now be assembled by two different methods:—

(1) Hand assembly, where the assembly is built up with the aid of a dental spatula. All wax runners made for hand assembly are cast in plaster moulds.

(2) Pouring-fixture methods, where jig assembly is used. In the instance shown in Fig. 12, compressor-blade wax patterns are being "plugged-in" to the assembly fixture and the feeding head is poured in by hand. This method involves a small tool cost, but reduces the assembly time by 75 per cent.

### Investing and Castings

Before recent developments in the processes of investing and casting are described, it will be of advantage to analyse the processes as set out in the previous paper and comment on deficiencies.

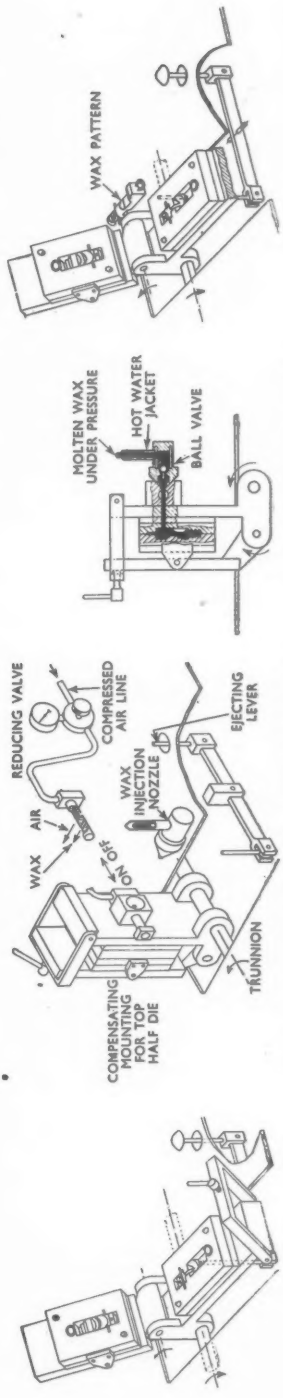



FIG. 6.—*Four stages in the operation of the universal wax-injection machine.*

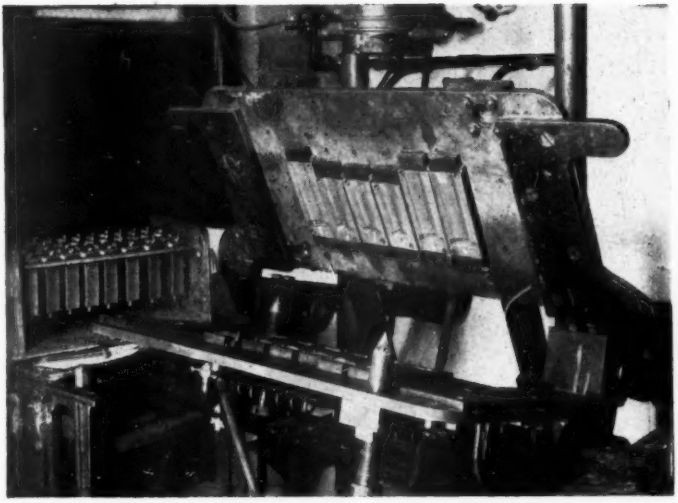


FIG. 7.—*Injection machine producing six wax patterns simultaneously.*

As described in that paper, the wax-pattern assembly was invested with an ethyl-silicate-bonded slurry, the wax was melted out by oven treatment, the mould was then fired at 1,000 deg. C. to remove all traces of wax, methylated spirits, water, etc., and to establish maximum mould porosity. The mould was cast with 5 lb. of molten metal, an air pressure of 2 to 10 lb. per sq. in. being used. The mould was then knocked out and the castings shotblasted, cut-off, etc. By a concentration on process control, it was possible to mass-produce castings with a scrap percentage of less than 30 per cent.

In considering the above, the most important development must necessarily be the reduction of scrap to the lowest possible percentage. An analysis of defective castings shows that scrap is mainly due to:—(1) Refractory inclusions; (2) trapped gas; (3) lack of definitions; and (4) defective surfaces.

(1) *Refractory Inclusions.*—The simplest way in which these occur is when pieces of refractory fall into the mould cavity just prior to casting. This can be overcome by the provision of a trap. It will be noted that a trap can be provided much more readily in a centrifugal mould—where the metal is thrown out sideways—than in a gravity type of mould—where the casting cavities are usually immediately below the mould ingate. Any refractory particle which breaks loose from the mould cavity will give rise to scrap. The following instances are enumerated: (*a*) Flaking of the primary coating; (*b*) fracture of fragile cores; and (*c*) fracture of the main body of the mould. All these are more usually associated with large castings, and may never occur where the components are less than 1 in. long.

Since the coefficient of expansion of the wax is usually ten times that of the mould material, it should be considered what is likely to be the physical state of equilibrium inside a mould 24 hours after it has been invested. If the mould is heated up or cooled down from the temperature at which the mould has been invested, the results are undesirable. If the mould is heated up, the thermal expansion of the wax will subject the cavity faces of the mould to severe pressures and will, in instances where fragile coring is used, fracture the mould. If the wax pattern is large enough in volume, this pressure may even split the mould. This is shown in Fig. 13 as it applies to an "Investment X" mould.

If the mould is cooled down, the results are far worse, since the wax which has a good adhesion to the primary coat will occupy a smaller volume than the mould cavity formed around it. The primary coat, in such an event, will be separated from the

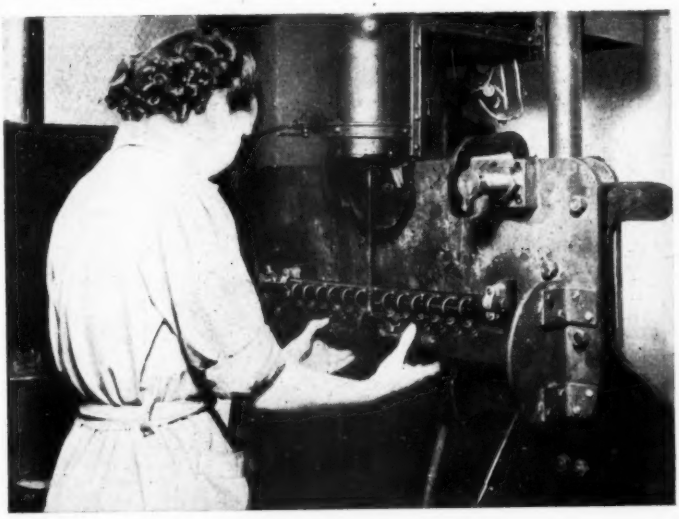


FIG. 8.—*Method of injecting wax into master valve—compressed-air pipes are seen leading into valve body.*

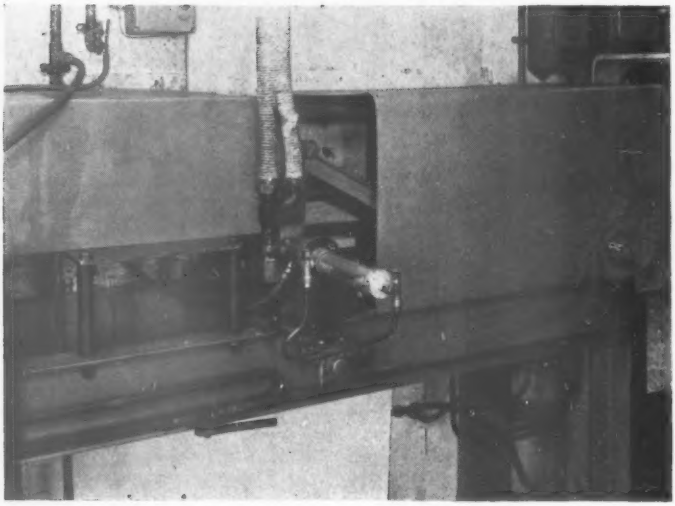


FIG. 9.—*Semi-automatic machine where die movement is hydraulically controlled and wax is injected through the die parting-line.*

mould. The worst havoc can be caused by cyclic heating and cooling of the mould such as might occur in industry during the summer-holiday period, when day temperatures are often widely different from those at night.

The solution to this fundamental difficulty is twofold:—(*a*) Storage of moulds after investing at a temperature which does not vary more than ±2 deg. C.; and (*b*) use of correct methods of wax removal. In regard to solution (*b*), two methods are advocated. The first is the removal of wax by oven treatment after the mould has been designed to resist pressure. This reinforcement takes the shape of a heat-resistant canister made from Nimonic 75 alloy, with tension bars of similar material cast in the mould. The second method is to dissolve the wax by the use of trichlorethylene or other suitable solvent.

This discussion of mould fracture will be incomplete unless two other factors are introduced: (*a*) adequate drying time before heating the mould, and (*b*) distribution of particle sizes throughout the mould.

(*a*) The first point is relatively obvious, since the mould will be far more likely to crack if it has only its "green strength" to resist the imposed stresses of wax pressure. A drying time of 48 hours at even temperature is recommended for an average size of mould 8 in. dia. by 8 in. high, since the mould may crack owing to too high a rate of gas-evolution if the firing cycle is premature.

(*b*) The second point relates to mould manufacture. It is desirable to consolidate a mould by vibration in such a way that all air is removed from the mould box. If the vibration is too severe when using a mobile moulding slurry, the heavier particles will sink to the bottom of the mould, and the lighter particles will be driven upwards. This unbalance of the particle distribution will later

FIG. 10.—*Wax pattern being ejected on a semi-automatic machine.*

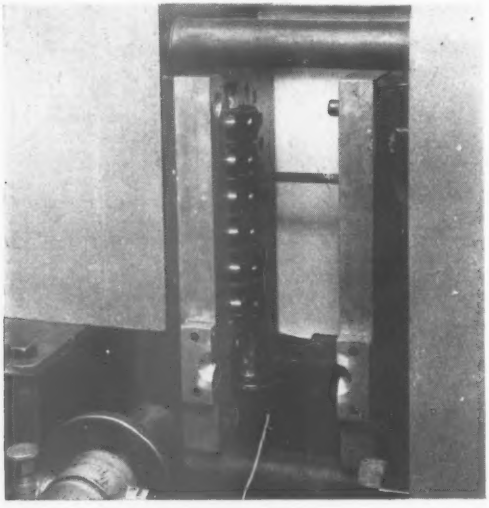
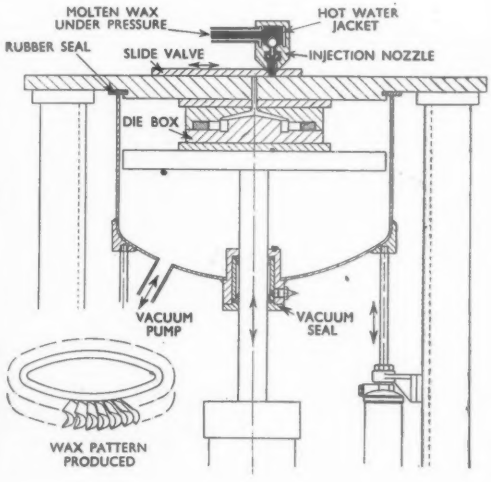


FIG. 11.—*Vacuum wax-injection machine shown diagrammatically.*



cause the mould to crack at the top and these cracks can easily be extended to vital parts of the mould, if assisted by other stresses such as wax pressure. Two solutions are applicable: first, to use refractory particles of similar specific gravity; or, secondly, to use a slurry which is extremely viscous and to limit the duration of vibration.

(2) *Trapped Gas.*—Trapped gases may be of two types:—

(*a*) There are the gases which come out of solution while the metal is solidifying in the mould—this is typical of mild steel. The cure is to kill the metal or to use alternatives. In borderline cases, gassing can be avoided by allowing the casting to solidify under considerable pressures.

(*b*) There are the gases which are trapped in the mould when the metal is poured into the cavity. These gases are normally oxygen, nitrogen, and carbon dioxide. This defect probably accounts for the largest proportion of the scrap in precision-casting foundries.

A number of papers dealing with lost-wax casting lay special emphasis on Durville pouring; others lay emphasis on the importance of the rate of pouring and its proportionality to the rate at which the air or gas will be displaced.

In regard to Durville pouring, this can well apply to the filling of a simple shape, but with the complex cavities of the average mould, the air cannot possibly come out through the runner system, so that the highest possible mould permeability is essential, if all gas is to be excluded.

In regard to the rate of pouring and its effect on complete gas exclusion, the Author's own view is that slow pouring can be justified in relatively few instances. Moulds should be poured as quickly as possible, and if gas is trapped it is the fault of either (*a*) low mould permeability or (*b*) inaccurate metal pressures.

(*a*) *High Mould Permeability.*—A high mould permeability is not always easy to obtain in solid-mould techniques owing to the relatively high percentage of fines used in the mould construction. As the percentage of fines decreases, the mould strength drops off sharply, and optimum mould characteristics often become a compromise between mould strength and permeability. Where mould permeability is essential, as in the casting of gas-turbine compressor blades in steels of relatively sharp freezing characteristics, the Investment X process, described later in this paper, gives excellent results, by providing a shell of highly permeable refractory backed by a packing investment of large particle size.

Permeability in solid-mould techniques is always dependent on effective removal of the wax. If the wax patterns are assembled in such a manner that the wax cannot drain out, the wax must necessarily be burnt out during the firing cycle. No concise idea of the time which may be required to burn out the wax can be made, except on a trial-and-error basis, with rigid control of gas-furnace atmosphere. This is made even more difficult when the wax percolates into the mould and has

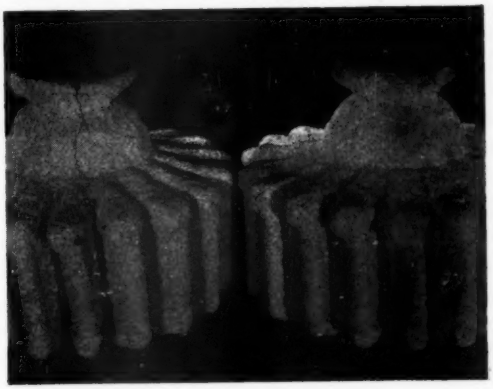
FIG. 12.—*Assembly of wax patterns by a "plug-in"—and—"pour" technique, reducing assembly time by 75 per cent.*

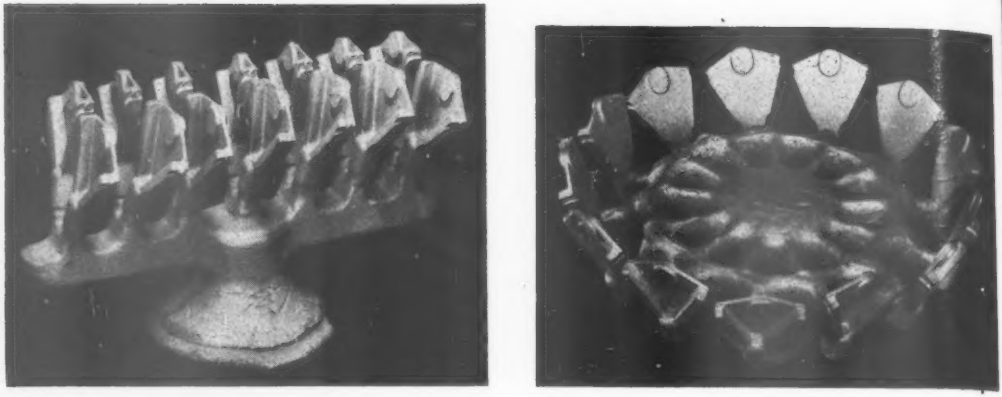
to be burnt out in the presence of very little oxygen. Again this will not matter so much where the pieces are extremely small, and where the mould is small, but will prove a major stumbling block when dealing with a large mould, say, 12 to 18 in. dia. and 10 in. long, which contains a large volume of wax.

It is important that the wax-removal problem should be dealt with adequately, either by the correct disposition of the wax patterns, or where, owing to shape, this is not possible, by joining ¼-in.

FIG. 13.—*Impracticability of de-waxing by oven treatment as compared with de-waxing in a trichlorethylene bath.*

(*a*) De-waxing by the thermal method (after 15 min.). (*b*) De-waxing by the trichlorethylene method (after 15 min.)





(*a*) *Armature castings.* (*b*) *Air-intake casting.*

FIG. 14.—*Wax assemblies.*

dia. wax rods from the lowest part of the wax patterns to the main runner.

Investment X moulds do not, however, suffer from the same disadvantages, since the wax is removed by the solvent action of trichlorethylene vapour. Even in instances where the wax cannot run out of the mould, the trichlorethylene/wax solution will drain out through the walls of the shell mould.

(*b*) *Accurate Casting Pressures.*—The pressure between the molten metal and the mould surfaces is all important, since this determines the surface finish of the casting, and is a controlling factor in the size of the casting.

In the process described in the Author's previous paper, the pressure applied between the metal surface and the mould surface is stated to be dependent on two pressures: (i) the metallostatic head of metal; and (ii) the air pressure of 2 to 10 lb. per sq. in. applied after the mould cavity has been filled.

(i) The consistency of the metallostatic head of metal is dependent on filling the mould cavity to the same level on every cast. This is a simple enough procedure, though in practice it does not always work out according to plan. For instance, the crucible may crack, the resulting fin of metal decreasing the crucible insulation. This will produce a short feeding head by virtue of the metal retained in the crucible. Alternatively, a furnace charged with insufficient metal or too much metal will give differing and inconsistent pressures.

(ii) The air pressure of 2 to 10 lb. per sq. in. applied after the mould cavity has been filled again is liable to variation, since the pressure is proportional to the air leak between the mould and the furnace top-plate. There are, indeed, instances where the air pressure applied will actually assist the trapping of gas in the mould cavity.

A long and complete investigation into the use of air pressures has convinced the Author that the best results are obtainable with a metallostatic head alone, and that the use of air pressure is an unnecessary complication which is best omitted. Castings made by this means have a limiting minimum sectional thickness of approximately $\frac{1}{16}$ in. when casting is done in solid moulds of optimum permeability.

(*c*) *Centrifugal Pressures.*—Where pressure casting is necessitated by virtue of thin sections, and high definition being required centrifugal pressure will give consistently good results. It is possible by this means to make castings with sections varying from $\frac{1}{16}$ to 0.010 in.

(3) *Lack of Definition.*—Where lack of definition is not due either to mould permeability or to inaccurate pressure, it may be due to: (*a*) metal cast at too low a temperature; or (*b*) the disposition of the mould cavities around the main feeder.

(*a*) Casting metal at the special temperature relies on workmanship of high order; it is also dependent on reliable pyrometry, and the excellence of the furnace crucibles, insulation, etc.

(*b*) Where the best possible results are required in the making of accurate castings, it is desirable that the pattern cavities should be spaced symmetrically relative to the main feeder. To illustrate this point, two groups of castings are shown in Fig. 14 (*a*) and (*b*).

Fig. 14 (*a*) has castings spaced evenly along a cross runner, with the main runner connected in the centre. In such a case the castings immediately below the main runner will be of different quality from that of the castings on the outside. This is because the centre cavities fill first, but do not get any pressure from the metallostatic head until the outer cavities have filled. The outer cavities will receive pressure much more quickly.

The second group (Fig. 14 (*b*)) are spaced symmetrically around a disc feeder. Preferentially, this set-up should be centrifuged, but even if gravity methods are employed, the results will be a considerable improvement on the casting group of the type shown in Fig. 14 (*a*).

(4) *Defective Surfaces.* Defective surfaces may be caused by a number of operational failures:—

(*a*) The primary coat may separate from the wax pattern during investment, allowing the investment liquid to fill the cavity thus formed. The cast surface will be proportionately misplaced and rough, and "furred" with silica deposit.

(*b*) The secondary coat may separate from the primary coat, allowing the metal to break through. In this event the casting will have a rough thin skin of metal cast on to its surface which when reduced by grinding will form a subsidence in the casting.

(*c*) Bad packing by vibration will cause a surface to collapse under casting stresses. This is a principal weakness in normal solid-mould technique, and is eliminated in the Investment-X process by the use of multiple-dip coats.

(*d*) Bad spraying of the primary coat whereby the surface layer formed lacks cohesion. When the casting is made, this surface will erode away, giving a rough finish, with a loss of accuracy.

(*e*) The use of refractory binders not fully hydrolysed, which will cause weak moulds.

(*f*) Heavy penetration of the primary coat during casting caused by the metal-pouring temperature being too high.

(*g*) Defective surfaces may also be caused by the contraction of a casting which is not effectively fed. This usually takes the form of "hot-spotting" in sharp corners and recesses.

(*h*) Oxide films, etc., will produce negative errors in cast surfaces.

*(To be continued)*

## Small, Round Coreprints

*By "Chip"*

The time was when a youngster commencing work in the patternshop was given a number of round coreprints to make by paring, thus giving him plenty of practice in the use of his hand tools. To-day, with the emphasis on increased production, much hard work has been eliminated in many patternshops by the installation of a sanding machine, whereby pieces can be cut on the bandsaw and finished on the sander without the need for hand paring.

Thus small round coreprints can be cut on the saw to the taper required and finished on the sander. If a ¼-in. dia. hole were drilled in the centre of such a print, then a jig fastened to the bed of the sander could be used to enable any number of prints to be prepared of correct diameter simply by working them around a ¼-in. dia. spindle on the jig.

This jig can be so made as to set the spindle at varying distances from the sander face, depending on the diameter of the print to be prepared. The sander, like other machine-tools in the patternshop, lends itself, with the application of simple jigs and fixtures, to the speedy production of parts of a repetition character.

## Drilling Titanium

As a result of a study made by the Production Engineering Research Association on the drilling of titanium alloy Ti 150A, the following conclusions have been reached:—

(1) The drill point angle and relief angle had marked effects on drill life. Superior results were obtained using a 105 deg. point angle and a 10 deg. relief angle.

(2) The drill life obtained using drills with a 25 deg. helix angle was superior to the drill life obtained when using drills with 10 deg. and 42 deg. helix angles.

(3) There was a marked reduction in drill life when cutting speeds and feed rates above 64 ft. per min. and 0.0014 in. per rev. respectively were used.

(4) When using a cutting fluid consisting of one part mineral oil, five parts soluble oil and 18 parts water, the drill life was 10 times greater than that obtained using a sulphurized neat oil and 40 times greater than that obtained using soluble oil at 1:20 dilution.

(5) There was no evidence to suggest that difficulties in drilling and facing titanium alloy Ti 150A were associated with work-hardening characteristics of the material.

## Sheepbridge Transfer

The direct holding of the entire issued share capital of the Sheepbridge Company, Limited, Chesterfield, is being transferred by the Iron and Steel Holding and Realization Agency to the Staveley Iron & Chemical Company, Limited. Since both companies are owned by the agency, the change will take the form of a book transfer, no cash being involved. The Sheepbridge Company will thus become a wholly owned subsidiary of Staveley Iron & Chemical, which in turn will remain in the agency's control.

As a preliminary to the reorganization, the agency states that the directors of the Sheepbridge Company, consisting of Mr. A. V. Nicolle (chairman), Lord Aberconway, Mr. L. C. Hodges, Mr. N. M. Peech, and Mr. T. Brown (managing director), resigned on December 15 by agreement with the agency.

Mr. S. W. Martin and Mr. M. C. Hanna, of the Staveley Iron & Chemical Company, were elected to the Sheepbridge Company's board, and since then three more Staveley Iron & Chemical directors have joined Sheepbridge—Sir John Green, Mr. S. N. Turner, and Mr. A. E. Biggs.

## Wild-Barfield Acquisition

Wickman Limited and Wild-Barfield Electric Furnaces Limited announce that agreement has been reached between the two companies whereby the induction-heating business of the former was acquired by the latter as from January 1. Manufacture of induction-heating generators and fixtures will continue as heretofore and continuity of service is also assured for Wickman a.h.f. induction-heating units already in use. Manufacture of the plant will continue at the existing address at Oxgate Lane, Cricklewood, London, N.W.2, for the present, after which it will be transferred to the works of Wild-Barfield Electric Furnaces, Limited, at Watford By-Pass, Watford, Herts, when rearrangement of production facilities will provide space to house it. All correspondence in connection with this subject should, for the time being, be addressed to Cricklewood. Mr. F. L. Gladwin, who has been associated with the Wickman induction-heating equipment since its inception, has been appointed sales manager of the induction-heating department by Wild-Barfield Electric Furnaces Limited.

## "No Room for Complacency"

At the annual luncheon in Birmingham last month of the Cold Rolled Brass and Copper Association, Dr. Alexander King, head of the Intelligence Division of the Department of Scientific and Industrial Research warned members that although Britain was enjoying a period of increasing production, there was no room for complacency and the need for higher productivity was greater than ever. Dr. King pointed out that other Western-European countries were increasing their industrial productivity rate more rapidly than Britain, although admittedly they had more room for improvement in comparison with the high standards set in the United States. At the end of the war, the output per man/hour in this country was approximately half that of America; in other European countries the productivity differential with the United States was put a few years later as eight to one. In the second quarter of 1954, Britain's total increase in industrial production over the comparable period of last year was seven per cent. That of Western Europe as a whole—even including several countries considered industrially to be under developed, was nine per cent.

Many factors had been put forward as having a great influence on productivity, Dr. King continued. It was becoming more and more generally agreed, however, that in the long run technological innovation in industry as a whole was the dominant factor. Technological achievements depended not only on an efficient research programme but also on the rate at which new ideas could be absorbed by industry. As an instance in which a technical innovation had produced a startling increase in productivity, Dr. King mentioned the introduction of a tower crane on a large housing estate which cut costs by 30 per cent. Directly, the innovation was only partly responsible for the improvement but it brought about a reconsideration of the whole process and the introduction of a new and expensive piece of equipment, often had this healthy effect.

"Americans had expressed the view that the best way of increasing productivity in this country would be to double or treble wages. Thus managements would be forced to improve their organization to use the precious labour force to the maximum advantage" Dr. King said. He stressed that the operations group of the Department of Scientific and Industrial Research was available to assist research organizations in improving methods and techniques. It must not be thought, he said, that the operations men were of the "long-haired" type or over-concerned with theory. The work was essentially practical and intimately bound up with facts and figures.

Presiding at the luncheon was the chairman of the Association, the Hon. John Grimston, M.P., and the president of the British Non-Ferrous Metals Federation, Mr. W. F. Brazener, was among the guests.

## Combating Labour Shortage

In an attempt to overcome the critical labour shortage which has become widespread in the Midlands, the Willenhall foundry of British Insulated Callender's Cables, Limited, are offering to provide living accommodation at the factory itself for workers filling six vacancies for skilled moulders. The firm plans to convert part of its canteen into a furnished dormitory and hire part-time staff to prepare meals and do housework. Furthermore, if the workers have to leave homes and families in other parts of the country, the accommodation, meals and service will be free.

## Scottish Industrial Trends

A record year as regards applications for additions to existing factory space has been experienced by Scottish Industrial Estates. This was revealed by Lord Bilsland, president of the Scottish Council (Development and Industry), in a review of industrial progress at the annual meeting of the council. Lord Bilsland said that 50 per cent. of the applications were from Scottish concerns, but the attraction of new industry from the United States had been one of the successes of the year. However, he urged a modification of the present official policy on the distribution of industry, so that facilities could be provided for industrial development whether within a scheduled development area or not.

The year 1954 had, on the whole, been a good year for Scotland, continued Lord Bilsland. The total number of unemployed was 55,466, which was only 2.6 per cent. of the insured population and approximately 6,000 fewer than in November, 1953. The latest issue of the digest of Scottish statistics showed that there was a substantial rise in production of seven to eight points between the first half of 1953 and the first half of 1954.

Turning to the record of the principal industries during the year, Lord Bilsland said that coal output continued to be very disappointing, especially when it was realized that the programme of development in the Scottish coalfields over the next 10 years would, if achieved, restore the level of annual output only to that of the immediate pre-war years—about 30,000,000 tons. Scottish steel production, which reached its post-war peak in the first half of 1953, had since then been at a slightly lower level. A major scheme was now being carried out which would result in a considerable expansion in Scottish steelmaking capacity.

The output of new construction in Scotland's shipbuilding yards had been maintained during 1954. Since 1952 order-books had been considerably reduced, but the course of freights and certain other pointers showed that there was in the meantime no cause for concern. Output in the engineering industry had risen more rapidly than in any other.

## Richard Haighton Expansion

Richard Haighton, Limited, ironfounders and precision engineers, Canning Street, Burnley, have completed the removal and expansion of their premises which has been going on for the past year. The firm, originally a small iron foundry, was started in 1864 by Richard Haighton, a Nelson wheelwright, and acquired the Canning Street, Burnley, premises in 1953. The new development has involved removal from the original centre of Nelson. Four sons of the founder entered the business which in 1894 became a limited company, and operated from Vulcan Ironworks, Nelson, from 1939. The Haighton family sold their interests in 1948 to Pope and Pearson, Limited, colliery owners, of Normanton, in the West Riding.

The new Burnley premises cover four and a half acres; 20,000 castings are being produced weekly. Most of these are fire frets and fireplace castings, but some are for engineering and machine-tools. Among the firm's products are a universal milling machine, glass milling machines, and centre lathes for model engineers. A modern vitreous-enamelling plant in the new premises is said to be the most up-to-date in the country.

# Cupola Development

## *Further Discussion af the Report of I.B.F. Sub-committee T.S.* 43

At the October meeting of the London branch of the Institute of British Foundrymen, held at the Waldorf Hotel, Aldwych, Mr. E. S. Renshaw, of the Ford Motor Company, Dagenham, and chairman of sub-committee T.S. 43 of the Institute, presented the interim report of the sub-committee; Mr. W. Wilson being in the Chair.

THE CHAIRMAN, introducing Mr. Renshaw, said the Report would cover the latest development in cupola design, which had been collated from installations all over the country. The Report had first been presented to the annual conference of the Institute in June of this year and had been so well received that the branch's programme committee had decided it was an essential item for this year's programme.

MR. E. S. RENSHAW then presented the Report and showed slides of the illustrations and tabular matter, picking out the major facts for emphasis.

MR. A. R. PARKES, opening the discussion, said it would appear from Mr. Renshaw's account that it was possible to run cupolas most advantageously with no pig-iron at all, and he was beginning to feel rather sorry for the makers of pig-iron. Perhaps the speaker could comment as to whether or not that was a completely frivolous idea.

Secondly, there was already competition, although perhaps not on the surface, between the seekers of scrap for steel-making and those who wanted it for ironfounding; again, there might not be available all the scrap that was desired for iron foundries, if the developments outlined in the Report resulted in a greater demand for scrap.

Thirdly, if Mr. Renshaw had unlimited means at his disposal what sort of cupola would he install in his own foundry?

MR. RENSHAW, in reply, said obviously the bulk of the work could not be applied to every cupola or every particular circumstance. The conventional cupola would be in use for a long time to come, but in his view it was important to have the reported information available, particularly for times of emergency when pig-iron could become scarce, a situation which had already been experienced in this country. At present materials prices, one could employ higher scrap charges to economic advantage, but prices and availability of materials were not the primary thought in technical investigations.

With regard to the effect on pig-iron makers, it must be remembered that pig-iron being the first stage in the manufacture of steel, the former remains a necessary commodity.

When using low-grade coke prone to giving high sulphur pick-up, in normal cupola practice a condition could arise when a foundry's own return scrap could not be absorbed and methods outlined in the Report could overcome this position. Regarding the type of practice one would adopt, this would be determined by the price and availability of materials at any particular time. Employing the units described, it was possible to change the slag practice overnight to meet varying circumstances, but the sub-committee did not suggest for a moment that conventional cupola practice was to be entirely replaced.

### Tuyere System

MR. B. LEVY said he was particularly interested in the water-cooled tuyeres, which seemed to possess many advantages, and it would be of interest to know what method of circulating the water was preferable and whether there was any possibility of pumping the water through so that instead of having cold air it would be at least warm?

MR. RENSHAW, in reply, said it was an interesting suggestion to attempt to recover the heat from the water and transfer that heat to the blast, but assuming heat-transfer equipment were available, it was unlikely that the temperature increase in the air would be sufficient to justify such an installation.

MR. LEVY then asked what the general method of cooling tuyeres was at the present time; was it simply pumping cold water through and draining it away, without re-circulating?

MR. RENSHAW replied that the effluent water could be re-circulated by passing it through a cooling tank, and replenishing the water lost by evaporation. This method had been described in a previous publication. The water could also be re-circulated for use, say, in spark-arrestors. In certain instances, the cost of water might prove to be greater than the cost of the refractory saved.

MR. J. BUTLER said the Report had referred to possible shortages of pig-iron and scrap iron and steel. Had Mr. Renshaw any special comments to make on the value of the hot-blast systems in relation to possible future shortages of the better grades of foundry coke? The National Coal Board had published a long-term production plan and had given a warning that supplies of the best grades of coking coal were bound to diminish and that they would be faced with the necessity of blending the best grades with rather lower grades of coking coal.

MR. RENSHAW, in reply, said that the factor of coke supply was a very important point and uppermost in foundrymen's minds. Sound, cold-blast cupola-practice had been based on the availability of good quality coke; when a deviation from that standard arose, difficulty would be presented and the advantage of pre-heated air became apparent. For large-scale production, hot blast was the immediate answer, but for the smaller foundry, present high installation cost made hot blast economically prohibitive.

As suggested by the questioner, one solution might be to take a proportion of higher-grade coke

* Report printed in the JOURNAL, July 8, and 15, 1954, and previous discussion reported in the issue of September 23, 1954

and eke it out with the low-grade fuel. Perhaps a more rational approach would be to divert the low-grade coke to the higher production foundry which could justify hot blast and reserve the good-quality coke for the low-tonnage foundry.

### Melt Control for Malleable

MR. CHILD asked whether it was possible for the hot-blast cupola user to calculate his charge in advance so that, for instance, in the production of malleable iron, where carbon control was very important, and to a slightly lesser degree silicon, it was possible to know how much one could lose? What determined whether one would just break even, and could the calculation of composition be done in advance so that one would know exactly what to expect?

The sub-committee had put forward a number of reasons to account for the advantage of hot-blast cupolas, which probably everyone agreed with. In Chicago, with one particular installation, one of the reasons why hot-blast cupolas had been introduced was to reduce the amount of dirt emitted from the cupolas, in order to fulfil the conditions and requirements of the Health Authorities. That advantage would probably apply equally in this country, and was a very serious factor in favour of hot blast.

MR. RENSHAW said, with regard to the first question, that the pre-calculation of charges was normally based on day-to-day experience in the absence of any accepted formula. The operating methods could be quickly standardized after a short period of trial and error, anticipating day-to-day variations. Carbon and silicon control would follow as with cold-blast practice, but these elements could still vary, say, with changes in coke quality. With regard to dust emission, the hot-blast unit was an expensive dust-catcher if solely used for that purpose.

MR. CHILD said he had raised the point in connection with malleable iron, because it was virtually a white cast iron. With the production of grey iron, one had a little more flexibility in connection with the fluctuations of silicon and carbon over a certain range, but in the production of malleable it was of first importance that no graphite should be present. If the silicon got out of hand, even if there was only a slight pick-up, or the carbon might be excessively high, one was confronted with a serious problem.

MR. RENSHAW, in reply, said Mr. Child presumably meant cupola-melted blackheart malleable, but there again it was a matter of control and standardization by virtue of experience, and in his view it was quite as simple to control the composition with hot blast as it was with cold blast once one standardized the charges and the operating details.

### Properties of Recarburized Iron

MR. J. F. CHAMBERS, referring to Mr. Renshaw's remark that probably the greatest factor leading to the increase in the consideration of and installation of hot-blast cupolas would be deterioration in coke quality, said he quite agreed with that, but if one was led to consider putting in hot-blast cupolas in order to use poor coke, one inevitably had to consider also a cheapening of the charge in order to pay for the installation. By increasing the steel-scrap content of the charge and recarburizing in the cupola, whether by hot-blast or otherwise, one could attain the same chemical composition as previously, but he wondered whether sufficient work had been done with highly recarburized iron to say that it was identical from the foundry point of view? Iron made from a very high proportion of steel scrap appeared to be very different in its behaviour in the foundry. Did that comment still apply to a highly recarburized iron melted under basic cupola conditions, and had there been sufficient experience to say whether such iron did or did not give increased foundry problems of the type so well known?

MR. RENSHAW replied that the effect on the physical characteristics of iron produced from hot-blast operation or carburized charges was outside the terms of reference of the sub-committee. He asked Mr. Chambers what effect would be anticipated from utilizing different charged materials giving a comparable final analysis for the metal.

MR. CHAMBERS expressed the view that even with the same composition there could be differences in both the degree of graphitization and tendency to shrinkage.

### Practical Example

MR. RENSHAW, in reply, agreed that some evidence did exist of these differences in normal practice, but the effect of hot-blast and basic melting had not yet been thoroughly investigated. He could, perhaps, quote one case from his own personal experience when comparing blast-furnace pig-iron with an iron of the same composition melted in a basic, hot-blast cupola. Re-melting these irons separately as base metal for electric-furnace charges and producing castings in a certain type of mould, it had been fairly obvious that the degree of carbide stabilization differed in the two types of metal. The basic-cupola metal produced a casting with a greater proportion of eutectoid carbide than the blast-furnace pig-iron. The effect on shrinkage must always be considered, but the importance of these effects should not be exaggerated.

### Tuyere Life

MR. F. C. EVANS said there was nothing in the Report relating to actual operating experience with the water-cooled tuyeres. It would be very interesting to hear what sort of life was obtained from the tuyeres, whether they were at all dangerous in operation, and what sort of water pressures they were run at. With the water-cooled jackets it was quite simple to run them at low pressure so that, if one did get a leak, the pressure of the cupola blast held back the water, but he did not feel so certain that the same would happen with tuyeres.

MR. RENSHAW said the tuyere life in one particular case had been 12 months, after which surface cracks developed. In order to avoid danger from leakage, careful attention should be paid to

slag fluidity to prevent the more-viscous basic slags freezing around the tuyeres. In the event of a leak developing, the water pressure could be reduced in the tuyeres, whereupon the wind pressure inside the cupola would hold back the water, as described by Mr. Evans in the case of jacket leaks. The mains water-pressure in the case quoted in the Report was 20 lb. per sq. in. There was little danger of tuyere burn-out if the well-known rules of cupola melting were observed and slag fluidity maintained.

### Bed Height

MR. COLLEDGE, referring to the height of the coke bed in the hot-blast cupola, said he imagined it would start off at a lower height which would bring about an increased melting rate, but if one did not preheat the recuperator, what was the length of time before one got away from the first rush of cold metal? In other words, if one did not pre-heat the recuperator and started with the lower bed height, one would presumably get a much decreased temperature at tapping—or should one start with a higher bed until the recuperator got the blast temperature up to that desired?

MR. DRISCOLL, whom Mr. Renshaw asked to reply, said that in the cases with which he was most familiar the bed height for hot-blast operation at the beginning of the melt was maintained virtually the same as with cold blast, because the recuperator in that case was not preheated. Thus, for the first few minutes the installation was working as a cold-blast cupola, but the bed height was, of course, higher than was eventually required when full hot-blast was achieved, and the surplus heat did, as had been suggested, help towards preheating the combustion chamber and recuperator.

Regarding the length of time taken to reach normal hot-blast temperature, assuming that the recuperator and combustion chamber were not preheated to any substantial extent, the period was normally about three-quarters of an hour.

### Preheating Period

MR. COLLEDGE remarked that that would appear to be another reason why hot-blast was not practicable for a cupola running only for a short period, if it took three-quarters of an hour to reach blast temperature, and one did not preheat the recuperator.

MR. RENSHAW thought there were greater considerations to be taken into account as to whether a unit could be installed for a small production plant than that particular one.

MR. COLLEDGE said presumably where founders preheated their recuperator they could start off straightaway with a reduction in the bed height and get the increased melting rate almost immediately.

MR. RENSHAW replied that Mr. Driscoll was not suggesting one had to wait three-quarters of an hour, but that the blast would not reach the maximum temperature under that time. However, part of that time was being utilized in the initial blowing prior to tapping, and the metal temperature would probably be quite high enough immediately the cupola was tapped.

MR. DRISCOLL confirmed that the blast temperature was up to 250 deg. C. probably ten minutes after blowing was started, but he had been referring to the one specific case. It was obviously possible to supply an installation with supplementary heating, with which one could operate with normal blast temperature immediately.

MR. RUCK, referring to the reported necessity for desulphurizing hyper-eutectic steel in the basic melting unit, asked whether that provision was more insistent in a hyper-eutectic steel than in a hypo-eutectic steel. Secondly, in diagrams numbers 5 and 6 he had noticed that the refractory lining was cut away considerably, near the melting zone, to enable a bigger melting zone to be used, and he wondered whether there was a possibility of a large amount of erosion taking place at those points, or whether there was anything which prevented such erosion.

MR. RENSHAW replied that a charge of hyper-eutectic composition gained little in carbon when melted with basic slags, but hypo-eutectic charges would absorb carbon to hyper-eutectic composition level, and under these conditions of melting, desulphurization was complementary. Sulphur pick-up by hypo-eutectic charges in acid slag practice was normally very high, but this was under control in basic melting. With regard to erosion, this was shown to be considerably less when the refractory was set back some distance behind the point of entry of the air, which was the reverse of what Mr. Ruck suggested.

### Optimum Operating Temperature

MR. PARKES said a number of hot-blast plants which he had seen and heard of in operation seemed to use blast at a rather lower temperature than designed for: was that because the full advantage of hotter blast could not be utilized, or was it just because there was less wear and tear on equipment at the lower temperatures?

MR. DRISCOLL, in reply, said he would challenge Mr. Parkes' suggestion. In plant "C," for instance, referred to in the Report, Table I showed that the optimum blast temperature was regarded as 550 deg. C., and in Table II the actual blast temperature was given as 500 to 550 deg. C. In fact those figures had been rather frowned upon by the recuperator manufacturers because that particular plant was designed for a blast temperature of only 450 deg. C. However, the higher operating temperatures seemed to result in no ill effects on the recuperator.

MR. PARKES said Mr. Driscoll's remarks concerned only one plant. He could quote one which was designed to run at 500 deg. C. and was actually running at about 350 deg. C. Was there any reason why some plants appeared to be more satisfactory if they were run at below their full capacity?

MR. RENSHAW, in reply, advised Mr. Parkes to visit further plants as, in the case he quoted, it would appear that the unit cited was not being operated to the best advantage. Assuming the recuperative unit was designed to give blast temperature in the region of 500 deg. C., there was no reason why the melting

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practice should not be regulated to take advantage of this temperature. The optimum temperature was that which the equipment was designed to give, and if this was 500 deg. C., then the plant could be operated without danger up to this temperature, but not, of course, in excess.

MR. EVANS said in his view there was some justification for Mr. Parkes' comments. The point apparently was whether, in particular grades of metal, it was disadvantageous to go above a certain temperature, and he was thinking chiefly of whiteheart malleable. There was a plant in this country in which the maximum rating of the blast heater was 500 deg. C. and yet the founders operating it would rarely exceed 430 deg. C. because they found that this was the most advantageous temperature, in particular because there was silicon pick-up above that temperature. Similar practice could be observed on the Continent in whiteheart malleable plants, which probably had a bearing on Mr. Child's remarks earlier. He could remember going to the starting up of a whiteheart malleable plant, in which the blast was preheated with gas and the blast temperature accidentally ran up to 500 deg. C. In that plant, it was the practice to have a silicon analysis taken every half-hour, and when the silicon results were available it was seen that when the blast temperature had risen they were well over the 0.7 per cent. silicon which was the maximum required.

### Vote of Thanks

MR. CHAMBERS, proposing a vote of thanks to Mr. Renshaw for the work that he and the sub-committee had put into the Report, said everyone who considered taking advantage of the developments of cupola design and practice looked at them in the light of his own circumstances, and necessarily all had different objectives and different points of view. However, whatever the objective, all the information available could be found, carefully collected, examined and analysed, in that Report and he had a tremendous admiration for the amount of work that had gone into its production. It was an outstanding example of the service that the technical sub-committees of the Institute could render to the industry.

The vote of thanks, having been seconded by MR. SALINGER, was carried with acclamation and the proceedings then terminated.

## Molybdenite Concentrate Prices

In announcing that it raised its price for molybdenite concentrate to $1.05 per. lb. of Mo contained in concentrate, loaded at Climax, Colorado, plus cost of containers, the Climax Molybdenum Company, New York, points out that the previous price change was made four years ago. Since then the company's wage bill has increased by 34 per cent. and there have also been cost increases in processing materials.

Following the US announcement, the Climax Molybdenum Company of Europe, Limited, London, states that an indication of its current price, c.i.f. UK, taking into account the costs of packing, freights, and insurance, based on the present rate of exchange, is 8s. 0½d. per lb. of Mo contained in the concentrate.

## Glasgow Locomotive Contract

North British Locomotive Company, Limited, Glasgow, has received an order for 25 main-line locomotives for delivery to the Indian Government Railways from the emergency procurement service of the US General Services Administration, Washington. It is understood that the steam locomotives will be of the "W.G." class. Early last year, the North British concern quoted for 100 of this class, but contracts for fifty each were placed with the Baldwin Locomotive Company (America), whose tender was higher, and with builders in Japan.

The North British Company's work position as regards locomotives is now none too strong—42 heavy locomotives are on hand for the Sudan and 26 for East Africa (in addition to a lesser number on the point of completion)—and the new order will be welcome even if it is not highly profitable. There is, of course, a not unimportant demand for "spares," and the company also now engage in a number of "sideline" manufactures, including Diesel engines. Locomotives of various types are, however, the main production, and it is hoped that negotiations now proceeding for the allocation to private builders of some of British Railways' requirements will bring benefit to the North British as well as to other undertakings. Such work, it is urged, would provide a basis for competitive production for export markets.

## Historical Ironworks Rebuilt

The first successful ironworks in America, the Saugus Ironworks, 10 miles north of Boston, Massachusetts, has been completely reconstructed as it was in 1646 at a cost of more than $1,500,000 (£525,000) after six years of research and construction to dramatize its historical and educational significance. News of this project was given in a letter to the "Sheffield Telegraph" by Mr. R. W. Allott, president of Sheffield Trades Historical Society.

The reconstruction at the Saugus Works has indeed been formidable. The 300-year-old blast furnace, 21 ft. high, producing 160 tons a year, has been rebuilt; the old water-wheel, 16 ft. dia., which was found lying 21 ft. under the main street of Saugus, has been copied, and there are now seven water-wheels giving power for the blast furnace, the forge, and the rolling and slitting mill. Tilt hammers are at work in the forge.

The Saugus Ironworks was founded by a London group called "Company of Undertakers for the Iron Workes in New England," and the total capital invested was £15.000-£60.000 at present values. Skilled workers were obtained from England.

LATEST employment returns show that there are more unfilled vacancies than there are unemployed workers. The number of unfilled vacancies on October 20 was 340,000, 63,000 more than a year ago. On the same date the registered number of unemployed was about 250,000. At the end of October there were 22,630,000 persons in civil employment, a gain of 20,000 over the month. Over 50,000 more people entered the manufacturing industries, 60 per cent. going into engineering, metal, and vehicle manufacturing.

Between mid-October and mid-November unemployment rose by 9,000 to 263,000. This represents 1.2 per cent. of the working population, compared with 1.5 per cent. in November, 1953.

# New Year Honours

*Awards to many people associated with the foundry, iron and steel, and allied industries were announced in the New Year Honours List. Some of the awards were published last week and others are given below, together with biographical notes on the principal recipients. For a number of the awards previously announced additional notes are appended.*

## BARON

SIR ARNOLD BABB GRIDLEY, for political and public services. Companies of which Sir Arnold is chairman include Carrick Engineering (Stewarton), Limited, Globelite Industries, Limited, Exeter, Mawdsleys, Limited, dynamo and motor manufacturers, of Dursley (Glos), Ross, Courtney & Company, Limited, manufacturers of motor fittings, etc., of London, N.19, and Southern Areas Electric Corporation, Limited.

## KNIGHTS BACHELOR

MR. WILLIAM GORDON BENNETT, MP for the Woodside Division of Glasgow since 1950, for political and public services. Mr. Bennett is a member of Glasgow Royal Exchange, of the Glasgow Chamber of Commerce, and of the Glasgow Trades House.

MR. DAVID ARNOLD SCOTT CAIRNS, chairman of the Monopolies and Restrictive Practices Commission.

MR. IVOR RICHARD COX, for services as managing director of Metropolitan-Vickers Electrical Company, Limited. Mr. Cox was elected to the board of Metropolitan-Vickers Electrical Export Company, Limited, in 1935, and in 1941 was appointed joint managing director, becoming managing director in 1944. In the same year he was elected to the board of Metropolitan-Vickers Electrical Company, and in 1945 became managing director of the company.

Mr. Cox is also a director of Associated Electrical Industries, Limited, the British Thomson-Houston Company, Limited, Sunvic Controls, Limited, and other companies.

COL. CHARLES VERNON FITTON, for political and public services in the North Riding of Yorkshire. Col. Fitton is vice-chairman of Parson & Crosland, Limited, iron and steel merchants, etc., of London, E.C.2, and a director of Dyson, Jones & Company, Limited, iron and steel merchants, of Middlesbrough, George Robinson & Son, Limited, London, E.14, and Scott Bros., Limited, Middlesbrough.

MR. ROBERT ALEXANDER MACLEAN, for services to industry in Scotland. Mr. Maclean is a director of Scottish Industrial Estates, Limited, and Hillington Industrial Estates, Limited. He was a part-time member of the Iron and Steel Corporation until his withdrawal in 1950. He has also served as a member of the Scottish Board for Industry and the Council of Industrial Design, of which he was chairman of the Scottish Committee. In addition he is a director of Glasgow Chamber of Commerce. More recently Mr. Maclean served as chairman of the Scottish Industries Exhibition, 1954.

MR. PHILIP ERIC MILLBOURN, honorary adviser on shipping in port to the Minister of Transport and Civil Aviation, and chairman and managing director of Spencer (Melksham), Limited, manufacturers of mechanical-handling plants and ironfounders, of Melksham (Wilts).

MR. LEONARD SINCLAIR, chairman and managing director of the Esso Petroleum Company, Limited.

MR. HENRY SPURRIER, managing director of Leyland Motors, Limited, who was elected president of the Society of Motor Manufacturers and Traders in 1952. Mr. Spurrier is also a director of Albion Motors, Limited, Self-Changing Gear Company, Limited, and West Yorkshire Foundries, Limited.

## ORDER OF THE BATH

### Civil Division

### GCB

BRIG. HAROLD POWELL CROSLAND, chairman and managing director of Metal Traders, Limited, and a director of Metal Market & Exchange Company, Limited.

MR. WILLIAM RANKIN MCGAW, Director-General of Aircraft Production, Ministry of Supply.

## ORDER OF ST. MICHAEL AND ST. GEORGE

### KCMG

The HON. GEOFFREY COKAYNE GIBBS, chairman of the Advisory Council, Export Credits Guarantee Department.

### CMG

MR. EDWARD WALTERS SENIOR, commercial director of the British Iron and Steel Federation. Mr. Senior, who was Master Cutler in 1947, is chairman of George Senior & Sons, Limited, and Padley & Venables, Limited, both of Sheffield, and of Ransome & Marles Bearing Company, Limited. Throughout the second world war Mr. Senior served in the Iron and Steel Control. After a period as General Director of Alloy and Special Steels, he represented the Control in Washington. He has served as a director of the British Iron & Steel Corporation, Limited.

## ORDER OF THE BRITISH EMPIRE

### Civil Division

### KBE

SIR (ARTHUR) WILFRID GARRETT, chairman of the Industrial Injuries Advisory Council. He was HM Chief Inspector of Factories from 1939 to 1946. (While he occupied that office, the "Report on Conditions in Ironfoundries" was issued, which now, colloquially, bears his name.)

MR. OWEN HADDON WANSBROUGH-JONES, Chief Scientist, Ministry of Supply.

### CBE

MR. C. S. BRYANT, lately Director of Materials and Explosives Research and Development, Ministry of Supply. MR. LEWIS CHAPMAN, managing director of William Jessop & Sons, Limited, and J. J. Saville & Company, Limited, steelmaking concerns, of Sheffield, has headed both companies for nearly 25 years. A member of the executive of the British Iron and Steel Federation, Mr. Chapman is also chairman of High Speed Steel Alloys, Limited, and Birtley Company, Limited, and a director of the Birmingham Small Arms Company, Limited. MR. M. W. GOLDBLATT, director of the industrial research laboratories of Imperial Chemical Industries, Limited. MR. J. L. GRAY, assis-

tant secretary, Ministry of Supply. MR. F. W. HALLIWELL, chairman and managing director of Arnott & Harrison, Limited, London, N.W.10, Gay's (Hampton), Limited, Hampton (Middx), and Peter Brasshouse, Limited, Birmingham. He is president of the Gauge and Tool Makers' Association. MR. H. W. HOBBS, Director of Ordnance Factories, Mottingham, Ministry of Supply. MR. F. J. HONEY, secretary, British Employers' Confederation. MR. H. E. JACKSON, lately president of the British Non-Ferrous Metals Federation. He became chairman of the metals division of Imperial Chemical Industries, Limited, in 1944, and retired in 1953. He has also served as president of the Aluminium Development Association and chairman of the Aluminium Industry Council. MISS DOROTHY JOHNSON, Deputy Chief Inspector of Factories, Ministry of Labour and National Service. MR. H. PARKER, Assistant Director of Dockyards, Admiralty.

## OBE

MR. JOSEPH BLEWITT, Midlands regional secretary, Transport and General Workers' Union. LT. COL. H. H. BROADBENT, TD, chairman and managing director H. Broadbent & Son, Limited; MR. A. E. GOLLOP, Assistant Director of Storage, Ministry of Supply. MR. P. L. GOULD, a member of the Welsh Board for Industry, is a director of Goulds Foundries, Limited, Newport (Mon), the British Arc Welding Company (Bristol Channel), Limited, and of Underwater Welders & Repairers, Limited. He is also vice-chairman of the Council of Ironfoundry Associations, and a member of the management board of the Engineering and Allied Employers' Federation. MR. J. T. HAYNES, general manager, Western Division, Southern Gas Board. MR. H. C. JOHNSON, divisional operating superintendent, Eastern Region, British Railways. MR. H. L. LINDARS, managing director of Dunford & Elliott (Sheffield), Limited, steelmakers. MR. D. H. REED, superintending examiner, Patent Office, Board of Trade. MR. E. L. RIPLEY, principal scientific officer, Structures Department, Ministry of Supply. MR. JACK SHACKLETON, engineering superintendent of design, Atomic Energy Authority. MR. ROBERT SPENCE, a director and general manager of John Hastie & Company, Limited, manufacturers of ships' steering gear, of Greenock. PROF. F. V. WARNOCK, head of the Department of Mechanical Engineering, Belfast Municipal College of Technology.

## MBE

MR. GILBERT ANDERSON, manager of the welding and fabricating department, Bruce Peebles & Company, Limited, Edinburgh; MR. T. C. BATTERSBY, general manager, Watford Division, Eastern Gas Board; MR. J. S. CHRISP, chief maintenance engineer, Consett Iron Company, Limited; MR. DONALD DUNSMORE, superintendent, Brush Electrical Engineering Company, Limited, Loughborough; MR. WALTER GEARY, assistant superintendent with the Metropolitan-Vickers Electrical Company, Limited, Manchester; MR. T. W. GREAVES, safety officer of the Dunlop Rubber Company, Limited, Birmingham; MR. F. W. T. HAMMETT, Principal Production Inspector, Admiralty; MRS. M. J. HETHERINGTON, lately senior executive officer, Department of Scientific and Industrial Research; MR. C. L. HUNT, chief clerk of J. Jeffries & Sons, Limited, ship repairers, of Avonmouth (Glos); MR. C. C. KNOWLES, works manager, William McGeoch & Company, Limited, brassfounders and engineers of Birmingham; MR. C. J. LEVER, works manager with Siemens Bros. & Company, Limited, West Hartlepool and Spennymoor (Co. Durham); MR. ROBERT LUMLEY, labour manager, John Readhead & Sons, Limited, shipbuilders and engineers, of South Shields; MR. F. P. MACRAE, manager of the structural shops of Sir William Arrol & Company, Limited, Glasgow; MR. FRANK MARRIOTT, works manager with Head Wrightson Steel Foundries, Limited, Stockton-on-Tees; MR. C. B. P. MORTON, assistant to the chairman of Matthew Hall & Company, Limited, chemical and industrial engineers, of London, N.W.1; MR. W. F. OFFORD, member, Sussex District Advisory Committee, London and South Eastern Regional Board for Industry; MR. W. H. PEATLING, apprentice supervisor, Telegraph Construction & Maintenance Company, Limited, Greenwich; COL. HAROLD PEPLOE, consultant to the Director of Ordnance Factories, Ministry of Supply; MR. F. S. PERRY, assistant manager, English Steel Corporation, Limited, Sheffield; MR. E. E. PHEASEY, works manager, Foster, Yates & Thom, Limited, heavy precision engineers, of Blackburn (Lancs); MR. W. E. PHILLIPS, chief draughtsman, Harland & Wolff, Limited, Bootle (Lancs); MR. W. S. READ, manager, Fraser & Chalmers Engineering Works, Erith (Kent); MR. H. E. TOOGOOD, assistant engineering manager, Humber St. Andrew's Engineering Company, Limited, Hull.

## BRITISH EMPIRE MEDAL

MR. HERBERT ADAMS, turner with Joseph Lucas (Industries), Limited, Birmingham; MR. HAROLD ADDISON, chief inspector, Burtonwood Engineering Company, Limited; MR. W. W. AKED, skilled electrical fitter, J. Stone & Company (Deptford), Limited, London, S.E.14; MR. WILLIAM BARBEN, head foreman of the gun mounting department, Vickers-Armstrongs, Limited, Barrow-in-Furness; MR. ROBERT COWAN, senior operator of lead-pipe extrusion, Associated Lead Manufacturers, Limited, Newcastle-upon-Tyne; MR. GEORGE CRESSWELL, foreman, Markham & Company, Limited, founders, mining engineers, etc., of Chesterfield; MR. J. H. EVANS, leading smith, Brown, Lenox & Company, Limited, engineers and steel-founders, of Pontypridd; MR. ALFRED FORMAN, head foreman engineer, Humber Graving Dock & Engineering Company, Limited, Immingham; MR. T. W. HOLDEN, chargehand fitter, Royal Ordnance Factory, Barnbow, Leeds; MR. WILLIAM JEFFERIES, senior skilled turner, Torrance & Sons, Limited, machinery manufacturers, of Bitton, nr. Bristol; MR. PATRICK KELLY, bricklayer's mate, Ransomes & Rapier, Limited, Ipswich; MR. ALFRED NIGHTINGALE, turner, British Insulated Callender's Cables, Limited, Prescot (Lancs); MR. JOSEPH RILEY, foreman of assembly department, British Timken, Limited, roller bearing manufacturers, of Birmingham; MR. W. M. ROBINSON, senior foreman, R. B. Pullin & Company, Limited, scientific instrument manufacturers, of Brentford (Middx); MR. EDWARD ROOKE, works technical officer (Grade III), fuel research station, Department of Scientific and Industrial Research; MR. M. W. WALLACE, wire-rod furnaceman, Guest Keen & Nettlefolds (South Wales), Limited, Cardiff; MR. J. W. WILSON, maintenance engineer, Sheenbridge Steel Castings, Limited, Sutton-in-Ashfield; MR. C. E. WITHERS, chargehand driller, Tyne Dock Engineering Company, Limited, South Shields; MR. G. T. WRIGHT, ironfoundry bench moulder; R. W. Crabtree & Sons, Limited, machinery manufacturers, Leeds.

## Dr. R. J. Sarjant

THE APPOINTMENT briefly announced last week of Dr. R. J. SARJANT as director of research of the British Steel Castings Research Association follows a distinguished career in a wide field of research in iron and steel and fuel technology. From 1946 to 1953, Dr. Sarjant occupied the Chair of Fuel Technology at Sheffield University. At one time he was head of the research department of Hadfields, Limited, and a local director of the company. He was awarded the Melchett Medal of the Institute of Fuel in 1950. During the war, Dr. Sariant did notable service with the Ministry of Fuel and Power as a member of the fuel efficiency committee and chairman of its education committee. He served on the Department of Scientific and Industrial Research committee which reported on the supply of fuel technologists and has been associated with several committees of the British Iron and Steel Research Association and the British Refractories Research Association.

## Status of Institutes

An appeal by the Institute of Fuel from a decision by the Lands Tribual on March 30, 1954, affirming a decision of a local valuation court that the Institute was not entitled to exemption from liability to rating was dismissed by the Court of Appeal, Lord Justice Jenkins dissenting. The Institute had contended that it was entitled to exemption on the ground that it was a society "instituted for the purposes of science . . . exclusively" within the meaning of Section 1 of the Scientific Societies Act, 1843.

The charter of the Institute stated, among its purposes, that it was (*a*) to promote, foster, and develop the general advancement of the various branches of fuel technology as an end in itself and as a means of furthering the more scientific and economic utilization of fuel of all kinds for industrial, commercial, public, agricultural, domestic, transport, and/or other purposes, and to promote, assist finance, and support such industrial and scientific research . . . (*d*) to uphold the status of members of the institute by holding or prescribing examinations for candidates for election and by requiring standards of knowledge and experience which can be approved. . . ."

The Master of the Rolls, reading his judgment, said that they had had no explanation of the expression "promotion of fuel technology"; but it was assumed that the Institute was a society instituted for purposes of science, and the sole question was whether it was "exclusively" so instituted within the Act of 1843. It was contended by the Crown that the objects of the Institute covered more than scientific objects and objects which were merely incidental to them, and in his (his lordship's) view that contention was right.

### Objects of the Institute

The objects of the Institute as set out in the charter included not only the advancement of the science of fuel technology, but also the persuasion of the public to economize in fuel by using appliances recommended by the Institute, and also the creation of a body of expert advisers of high professional status, his lordship continued. The present case differed substantially from Institution of Civil Engineers *v.* Inland Revenue Commissioners, where that institute was held exempt from income tax, and the words of Lord Hanworth, Master of the Rolls, were applicable in this case—that "if there is as an object, *e.g.*, the promotion of the profession in addition to the promotion of science, that is collateral and not merely incidental," the result would be different. One object of the Institute was to enhance the standing and prestige of fuel technologists as professional men, and in his view the decision of the tribunal was right and the appeal should be dismissed.

Lord Justice Jenkins, dissenting, said that a distinction must be drawn between the objects of an institution and the means adopted for attaining those objects. In his view the objects aimed at in paragraph (*d*) were the promotion of the science of fuel technology, and any advantages accruing to members of the Institute were purely ancillary and were not substantive objects. He would allow the appeal.

Lord Justice Birkett agreed with the Master of the Rolls. In his view paragraph (*a*) of the objects included objects which were commercial and social as well as scientific; and paragraph (*d*) included the establishment and the upholding of the professional status of fuel technologists, not as merely incidental to the carrying out of scientific objects but as a substantive object in itself.

## Industrial Injuries Cases

### Damages for Injured Moulder

After summing up for nearly an hour at Chesterfield County Court, Judge Sir Henry Braund awarded a Barrow Hill moulder £40 damages. He was John William Thacker, who had claimed £150 from the Staveley Iron & Chemical Company, Limited, by whom he had been employed as a moulder for 30 years. At a previous sitting of the County Court, Judge Braund, after hearing evidence, had deferred judgment for seven days.

The reason for the claim said the judge, was that Thacker, while carrying out an experimental method of "skin drying" pattern moulds at the works of the Staveley Iron & Chemical Company, on March 26 last, had sustained a toe fracture when an iron clamp used in the process had fallen on his foot.

The judge came to the conclusion that the operation was extremely dangerous, that the company's agents did not supervise, advise, or help Thacker, and that Thacker was Not Guilty of contributory negligence. He did not think that the defendant company was justified in leaving Thacker to use his own initiative on an experimental operation about which he knew little.

### £3,150 Award for Widow

The widow of a man who was crushed to death while at work was awarded £3,150 agreed damages by Mr. Justice Ashworth, at Birmingham Assizes. She was Mrs. Bertha Rose Eagle (27), of Witton Lodge Road, Erdington, Birmingham, who sued James Booth & Company, Limited, non-ferrous metal manufacturers, of Birmingham.

Mr. G. Heron, who appeared for Mrs. Eagle, said that her husband, William Frederick Eagle, was assisting in the installation of a new heat-treatment furnace at the defendant's works on October 28 last year, and had to go down into a pit to screw down some bolts. An electrician who was also helping with the installation started some mechanism which released a heavy steel bar, crushing Eagle, who died the same day.

The judge apportioned £1,250 of the award to Mrs. Eagle's three-year-old daughter.

## Iron-ore Imports

Iron-ore imports in November and the total for the first 11 months of last year compared with the corresponding period of 1953 are shown below.

| Country of origin. | Month ended November 30. | Eleven months ended November 30. | |
|---|---|---|---|
| | 1954. | 1953. | 1954. |
| | Tons. | Tons. | Tons. |
| Sierra Leone | 78,275 | 726,158 | 580,708 |
| Canada | 79,494 | 1,028,043 | 900,656 |
| Other Commonwealth countries and Eire | 855 | 187,459 | 34,601 |
| Sweden | 335,698 | 3,508,355 | 3,845,328 |
| France | 41,776 | 410,081 | 413,031 |
| Spain | 48,446 | 411,575 | 465,446 |
| Algeria | 143,161 | 1,713,792 | 1,945,990 |
| Tunisia | 49,870 | 525,545 | 564,202 |
| French Morocco | 17,144 | 246,567 | 237,030 |
| Spanish Morocco | 16,950 | 244,655 | 239,212 |
| Liberia | 9,400 | 246,563 | 197,782 |
| Brazil | 55,022 | 280,158 | 432,309 |
| Other foreign countries | 60,548 | 612,237 | 851,678 |
| TOTAL | 936,639 | 10,141,188 | 10,707,973 |

# Personal

Lord HIVES, chairman of Rolls-Royce, Limited, is to visit the United States. It is understood that he will leave England on January 14.

Mr. H. P. PENTELOW, after 51 years' service with the Trafford Park Works of Lancashire Dynamo & Crypto, Limited, retired at the end of 1954.

Mr. W. D. K. MARSHALL has been appointed deputy chairman of the board of directors of Wm. Denny & Bros., Limited, shipbuilders, Dumbarton, as from January 1.

Mr. E. S. SELLERS, Lecturer in Chemical Engineering, Cambridge, has been appointed to the newly-established Chair of Chemical Engineering at the University College of Swansea.

Dr. W. D. SCOTT has left Monsanto Chemicals, Limited, to join the British Tyre & Rubber Company, Limited, as personal assistant to the managing director, Mr. P. W. Howard.

Sir OLIVER FRANKS, chairman of Lloyds Bank and a member of the Iron and Steel Holding and Realization Agency, has been appointed a director of the Bank of London and South America.

THE EXPORT CREDITS GUARANTEE DEPARTMENT announces that Mr. T. EATOUGH, CBE, director of the department's Short-Term Underwriting Division, retired from the public service on December 31.

Mr. ROBERT MCAULEY has retired after 40 years' service with George Fletcher & Company, Limited, engineers, Derby. He was presented with a clock by the managing director, Mr. C. W. Murry, on behalf of the directors.

Mr. HARRY JINKS, who has celebrated his 85th birthday, has completed more than 65 years with William McGeoch & Company, Limited, electrical engineers and brassfounders, of Birmingham, where he works as a part-time brass dresser.

Mr. RICHARD TINGEY has been appointed technical manager of the Bethlehem Steel Company (Shipbuilding Division). Mr. Tingey, who has been assistant manager since 1944, succeeds Mr. John E. Burkhardt, who died last October.

Mr. D. W. ALDRIDGE, deputy chairman of British Insulated Callender's Cables, Limited, has been appointed a director of Ndola Copper Refineries. BICC has agreed to provide £1,000,000 in respect of one third of the share capital of that company.

Mr. C. E. GOODWIN, joint managing director of Bank Hardware, Limited, has been elected chairman of the Walsall branch of the National Union of Manufacturers. On prospects for 1955 Mr. Goodwin said he was expecting "an absolute boom in trade."

Sir HUGH WARREN, managing director of Associated Electrical Industries, Limited, has retired. Sir Hugh is a director of the British Thomson-Houston Company, Limited, Metropolitan-Vickers Electrical Company, Limited, Siemens Brothers & Company, Limited, and several other companies.

Mr. E. W. S. PRESS, who has been assistant director in charge of general stores of the Ministry of Supply at the Chemical Inspectorate, Woolwich, since 1948, has been promoted to deputy chief scientific officer and appointed director of Chemical Inspection, Kidbroke, London, S.E. He is 56.

Mr. HARRY CANTRILL, chief quality engineer, at Rolls-Royce, Limited, Derby, has retired, after a lifetime devoted to the construction of engines. He has been associated with the firm since 1937. He will be succeeded by Mr. F. NIXON, assistant general manager in charge of manufacturing processes at Derby.

FIRST PRIZES and City and Guilds of London Institute medals have been gained by two students of Sheffield College of Commerce. They are Mr. LESLIE FOX, whose bronze medal was won for patternmaking (intermediate grade), and Mr. JOHN MICHAEL JAMES, whose silver medal was won for heating-and-ventilating-engineering practice (final grade).

Dr. T. ROBERTSON, assistant director (England and Wales), will retire from the staff of the Geological Survey and Museum on March 31, and will be succeeded by Dr. F. M. TROTTER, at present district geologist in charge of the Manchester office of the Geological Survey. Mr. J. V. STEPHENS will become district geologist at Manchester.

Dr. H. BAKER, principal of the Nottingham and District Technical College, is to retire next August. He will be succeeded by Mr. D. A. R. CLARK, who from 1932-1936 was a lecturer at Heanor Technical and Mining School; from 1936-1939 was head of the Engineering Department at Luton Technical College, and from 1947 has been principal of the Constantine Technical College, Middlesbrough.

Mr. JOHN L. ANSTEY, a well-known Warwickshire sportsman, was on January 1 appointed sales director of the Parkinson Stove Company, Limited, Stechford, manufacturers of domestic gas appliances. On demobilization from the RAF in 1946, Mr. Anstey joined the firm as a junior representative, and was appointed senior representative in 1948. Two and a half years later he was promoted to Midlands area manager, and in November, 1952, to the post of sales manager.

BIRMINGHAM UNIVERSITY COUNCIL on January 5 accepted the resignation of Professor A. H. COTTRELL, Professor of Physical Metallurgy, who is to take up an appointment at the Atomic Research Establishment at Harwell. The Council also accepted the resignation of Professor ARNOLD TUSTIN, Professor of Electrical Engineering, who has been appointed to the Chair of Electrical Engineering at the Imperial College of Science, London University, where he will begin his duties in August. The Council approved the appointment of Dr. T. L. IBBS to a personal chair in the Department of Physics.

Mr. H. E. ELLIOTT, public relations officer to Newton, Chambers & Company, Limited, Sheffield, and Mr. R. C. BURGIN, the company's assistant secretary, retired at the end of 1954. Mr. Elliott joined the firm in 1935 from the "South Yorkshire Times," of which he was Editor. Mr. Burgin had been with the firm since 1907, becoming chief counting-house clerk in 1924, cashier in 1928, and assistant secretary in 1941. At a luncheon in the staff dining room at Thorncliffe Works on December 30, attended by nearly 100 managers of the firm, Mr. R. J. V. Wheeler, on behalf of the assembly, presented a nest of tables to Mr. Elliott, and an inscribed silver tray to Mr. Burgin.

Mr. FRANK GREENWOOD BURRELL and Mr. THOMAS ROBINSON FERENS, joint managing directors of Shipham and Company, Hull, and George Clark and Sons (Hull), the whole of the capital of which was recently acquired by Newman Hender and Company, Limited, have been appointed additional directors of the company. Mr. N. P. NEWMAN, Mr. F. R. NEWMAN and Sir JOHN LYELL LANGMAN, Bart, who are all directors of Newman Hender and Company have been appointed to the boards of Shipham and Company and George Clark and Sons (Hull). Mr. N. P. Newman has been appointed chairman of the boards of Shipham and Company and George Clark and Sons (Hull).

# News in Brief

QUALCAST, LIMITED, of Derby, is to extend the foundry capacity.

AITON & COMPANY, LIMITED, pipework engineers, of Stores Road, Derby, will make some small extensions to their works at an early date.

FIGURES issued by the Ministry of Labour show that fewer boys entered the metal and engineering industries as apprentices in 1953 than in 1952.

THE EIGHTH CANADIAN INTERNATIONAL TRADE FAIR, sponsored by the Canadian Government, will be held in Toronto from May 30 to June 10. Engineering and machine tools will be the largest sections.

BUTTERLEY COMPANY, LIMITED, of Ripley, have booked the Derby Hippodrome, for two nights this month, to enable 3,000 employees to visit the pantomime "Babes in the Wood."

G. STIBBE & COMPANY, LIMITED, hosiery-machinery manufacturers, of Leicester, have opened showrooms in the French textile centres of Troyes, Roanne, and Roubaix.

THE NATIONAL TRADES TECHNICAL SOCIETIES, with the co-operation of the Sheffield branch of the Institute of British Foundrymen, are proposing to hold a foundry exhibition to take place at the Cutlers Hall, Sheffield, from May 16 to 18.

LONG-SERVICE AWARDS have been presented to 14 employees of Head, Wrightson & Company, Limited, Thornaby-on-Tees, who have completed 50 years with the company and to a further 45 workpeople with 40 years' service.

IN the 41st Thomas Hawksley Lecture "Recent Studies of Metallic Friction," presented to the Institution of Mechanical Engineers, it is disclosed that most probably ball-bearings were first fitted—to a post-chaise—in 1772.

THE Federation of Light Metal Smelters reports that its members' average selling prices (to the nearest 10s.) for the following alloys during the month of November were:—LM1, £150 per ton; LM2, £157 10s.; LM4, £161; LM6, £181.

ORDERS for 3,000 open wagons, costing £6 500,000, have been placed by the South African railway administration. Dorman, Long (Africa), Limited, will supply 1 000 wagons and the other 2,000 will be obtained from German firms.

THE BRITISH INSTITUTE OF MANAGEMENT, in association with other bodies, is arranging a management conference to be held at Droitwich on February 4 and 5. Details are available from the secretary of the Institute, at 8, Hill Street, London, W 1.

NEW GENERATING PLANT installed by the British Electricity Authority during the year ended December 31, 1954, yielded an additional output capacity of 1,431,000 kW, or nearly 2,000,000 h.p. This compared with 1,413,000 kW installed in 1953.

THE FIRST INTER-WORKS VISIT of 1955 organized by the Hull Productivity Committee took place recently when a tour was made of the works of G. Waddington & Son, Limited, tanners and glove manufacturers, by a team from T. J. Smith & Nephew, Limited, Hull.

THE committee of trade and industry on the heavy goods vehicles speed limit recently passed a resolution calling on the Minister of Transport to raise the speed limit for heavy goods vehicles from 20 to 30 m.p.h. "in the interests of national productivity."

THE MANUFACTURE and sale of moulding powders, synthetic resins, and other plastic raw materials, at present carried out by British Industrial Plastics, Limited, at its factories at Oldbury, have been transferred to a wholly-owned subsidiary company, B.I.P. Chemicals, Limited.

THE BOARDS of Thomas De La Rue & Company, Limited, London, W.1, and Sidney Flavel & Company, Limited, Leamington Spa, announce that they have entered into negotiation with a view to merging their interests in the manufacture and marketing of gas, solid fuel, and heating appliances.

AFTER TWO YEARS of operations in the Union of South Africa, Polygram Shell Mould Company (Pty.), Limited, now claims that with twelve licensees operating the process, the percentage (7.6 per cent.) of foundries shell moulding is already higher in South Africa than any other country in the world.

PRODUCTION OF STEEL in West Germany in 1955 is forecast at 19,000,000 tons. It was reported from Düsseldorf recently that production increased in 1954 to 17,432,000 tons. The previous year's output was 15,419,300 tons. Output during the closing quarter of 1954 amounted to about 4,800,000 tons.

ISHRA is expected to issue a statement shortly to confirm rumours that Staveley Iron and Chemical Company, Limited, have acquired a controlling financial interest in the Sheepbridge Company, Limited. Both firms are to be disposed of by the agency and the £9,000,000 merger expected to be announced may be the preliminary to disposal to private ownership.

THE FILM "Britain's Largest Casting" was shown for the first time in Sheffield on January 3 at a meeting of the Sheffield and District branch of the Institute of British Foundrymen at the College of Commerce and Technology, Pond Street. The film, which shows the making of a 185-ton casting, was made by the film unit of the English Steel Corporation.

A BRANCH OFFICE has been opened by Hamworthy Engineering Company, Limited, Poole (Dorset), and its subsidiary, British Combustion Equipment, Limited, at Coronation Buildings, 65, Quayside, Newcastle-upon-Tyne (telephone: Newcastle 29657). The North-East Coast representatives of the companies and the service engineers now operate from the new address.

NUMBERS 25 to 31, of the "FactVeyor" blotters issued by J. Collis & Sons, Limited, convevor manufacturers, of Regent Square, Gray's Inn Road, London, W.C.1, deal respectively with conversion factors for cubic measure and capacity; table of dilutions; discounts (two tables); profit as a percentage on cost price; weather maps, and miscellaneous linear measurements.

A NEW WATER SUPPLY undertaking for the Redbourn Steel Works at Scunthorpe was opened on January 4 by Mr. Cyril Cooper, engineer to the North Lindsey Water Board. It includes a pipe-line running for five and a half miles from the River Trent, and cost £250 000. It is part of the development and modernization of plant being carried out by Richard Thomas & Baldwins, Limited, at a cost of about £2 million.

THE INSTITUTO NACIONAL DE INDUSTRIA of Spain has ordered power plant with a total output of 142,500 kW, and valued at about £2,000,000, from Metropolitan-Vickers Electrical Export Company, Limited. Six steam turbo-generator sets are to be supplied with condensing, feed-heating, and evaporating plant. All the equipment will be manufactured at the Metropolitan-Vickers works at Trafford Park, Manchester, and Germiston, Glasgow.

## *News in Brief*

THE LEITH FIRM of combustion engineers, Laidlaw, Drew & Company, Limited, have obtained a £24,000 contract from London County Council to supply oil-firing equipment for the heating boiler plant at London County Hall. The contract covers the supply and installation of automatically controlled oil-firing equipment for a battery of two John Thompson water-tube and six Cochran economic type boilers.

LEEDS ART GALLERY COMMITTEE, which already lends pictures from its collection to the Yorkshire Copper Works, Limited, and a Royal Ordnance Factory, has planned to organize exhibitions of about 15 to 20 pictures on a particular theme and circulate them to factories. The interest shown by factory managements in the display of works of art has led to the project, thought to be the only one of its kind in the country.

IN THE VILLAGE SMITHY at Kingham, near Chipping Norton, two brothers, Frederick and Reginald Rathbone, are making new wrought-iron gates for the Royal Enclosure Entrance at Ascot. For the past three months they have been beating out and welding more than 1,000 ornate pieces of iron for the gates which, when completed, will stand 15 ft. high and measure about the same distance across. The gates have been designed by the Rural Industries Bureau.

AT MIDNIGHT on December 19 the employees at the Ruabon factory of Monsanto Chemicals, Limited, completed two million man-hours of work without a single lost-time accident. The factory employs approximately 2,000 men and women on the production of industrial chemicals and commenced its unbroken accident-free run on July 17, 1954. This establishes a new record for the Ruabon factory, the best previous achievement being 1,799,670 accident-free man-hours set up in June, 1938.

BRITISH ROAD SERVICES have decided that, as from January 1, in cases where loss, damage or destruction is caused to merchandise by fire or explosion whilst in transit, they will not invoke proviso (1) to Condition 4 of their "Conditions of Carriage"; and will not, therefore, seek relief from such liability solely on the ground that they have exercised all reasonable foresight and care in the carriage of the merchandise. It is felt that this concession will be of considerable value to traders.

THE *Bureau International de la Récupération* (*B.I.R.*), the international organization of the waste trade, will hold a congress on February 2, 3 and 4 in London. All meetings, the Press conference and the combined luncheon for delegates from the various nations represented will take place at the Piccadilly Hotel and the official dinner/dance and cabaret show will be at the Dorchester Hotel (February 3). Scrap iron and steel will be dealt with in technical session on February 3 at 9.30 a.m., and non-ferrous metals at the same time on the following day.

LEYLAND MOTORS, LIMITED, announce that since the merging of Leyland and Albion interests, arrangements have been made for increasing facilities for the provision of combined service for both makes of vehicles at various depots of the two companies, *i.e.*, from the Leyland depots at Plymouth and Nottingham and the Albion depot at Sheffield. It is announced that as from January 1, 1955, co-ordinated sales-and-service facilities are in operation at the Albion depot at Hull. The address of the depot is 80/84, Cumberland Street, Wincolmlee, Hull; (telephone: Central 31073).

THIS YEAR, aspects of factory management and welfare will be included among the exhibits of the third National Factory Equipment Exhibition at Earls Court, London, on March 28. Three conferences will be staged concurrently with the six-day exhibition. The National Industrial Fuel Efficiency Service is presenting a series of talks showing that "fuel efficiency pays," the British Productivity Council is arranging a one-day conference on work study, and the Institution of Works Managers will hold its national conference during the last three days of the exhibition.

ONE-HUNDRED-AND-SEVENTY-FIVE EMPLOYEES of N. Hingley and Sons, Limited, Netherton, with more than 40 years' service, were entertained by the management to a dinner and concert on January 1. Their years of service total 8,288 averaging 47.9 each. Mr. J. Morgan has been with the firm for 68 years and two of his sons have completed 40 years; ten other employees started with the company more than 60 years ago while 49 have passed the 50-years' service mark. Mr. C. E. Lloyd, chairman of the company, and Mr. P. Jump, a director, thanked the men for their long and loyal service.

ARRANGED JOINTLY by the Birmingham Productivity Association and the Office Management Association, a one-day conference and exhibition will be held on January 31 at the Grand Hotel, Birmingham, on "Correspondence and mailing—your mail and how to handle it." About 30 manufacturers will be showing their products. Speakers at a conference luncheon will be Mr. Harry Spencer, managing director of Richard Thomas & Baldwins, Limited, and chairman of the British Institute of Management, and Mr. Norman Lancaster, a member of the Council of the Birmingham Productivity Association.

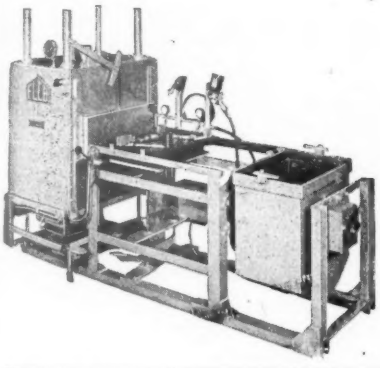
THE ENGLISH STEEL CORPORATION, LIMITED, Sheffield, has announced the dividing of its interests into four new companies, with head offices in Sheffield. The four new companies are:—English Steel Forge and Engineering Corporation, Limited; English Steel Rolling Mills Corporation, Limited; English Steel Castings Corporation, Limited; and English Steel Spring Corporation, Ltd. The English Steel Corporation has operated as the parent company from the New Year. Employees will not be affected, 10,000 are employed in Sheffield, and 7,000 in Manchester and Darlington. No changes are to be made on the board of the holding company.

THE BRITISH OXYGEN COMPANY, LIMITED, together with Gesellschaft für Linde's Eismaschinen A.G. of Wiesbaden, Germany, has formed a new concern—British Oxygen Linde, Limited—for the purpose of handling the sales of "tonnage oxygen" plant. "Tonnage oxygen" supply does not include provision for such matters as the oxygen blow for, say, electric furnaces in the foundry, but applies to the really large quantities as, for instance, those envisaged in the iron and steel trades and the chemical industry. Another activity of the new company will be the sale of plant for separating and purifying the constituents of coke-oven-gas and the like.

COURT WORKS, LIMITED, of Madeley, a leading East Shropshire foundry, belonging to the Heenan & Froude Group, which produces malleable and grey iron castings for the engineering, electrical, automobile and machine-tool industries, are introducing the group's new pension scheme for their 150 workers. The scheme is non-contributory and benefit will be provided wholly at the company's expense. The managing director, Mr. Reginald Edward Nutt said: "The company greatly appreciating the loyalty of their employees over many years, will provide a pension on retirement, or, should the member die before retirement, a lump sum will be paid to his dependents.

# SHELL MOULDING AT LOW COST

The Shelmolda 'Duplus' is low in first cost, economical to operate and costs little to maintain. Its design is simple and straightforward, yet it has the advantages of more complicated and costly apparatus. Operation is semi-automatic, with all the strenuous work carried out mechanically. The patent oven is thermostatically controlled and gives the machine a proved capacity of 50/60 moulds per hour. Pattern plates measure 24in. by 16in. and the maximum depth of pattern is 5in. Floor space required is 8ft. 6in. by 3ft. 3in. and the machine is operated by one man. Cost of the Shelmolda 'Duplus' is £575; delivery is 8 to 10 weeks.



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DUPLUS

PATENT APPLIED FOR

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236/73

# Obituary

Mr. WALTER HARTLEY, a former director of Dobson & Barlow, Limited, textile engineers and foundrymen, of Bolton (Lancs), died recently at the age of 72.

Mr. JOHN ERIC CHAMBERLAIN, chairman and joint managing director of Switchgear and Cowans, Limited, Manchester, died on December 31, at the age of 63.

Mr. ROBERT SPENCE GARDNER, late chief draughtsman of Shanks & Company, Limited, sanitary engineers and ironfounders, of Barrhead, near Glasgow, died on January 4.

Capt. J. F. W. MUDFORD, North-East Coast area training officer of the British Iron and Steel Federation, died recently at the age of 56. He retired from the Royal Navy six years ago.

Mr. ALEC MAGSON, production works manager at Armstrong Siddeley Motors, Limited, Coventry, died on January 3 at the age of 59. He joined the firm in the early 1920's and became chief draughtsman in the aero-engine section. He was appointed production works manager after the last war.

THE DEATH at the age of 86 is announced of Mr. HOWARD FOULDS, FCIS, who was for 26 years secretary of the former Callender's Cable & Construction Company, Limited. He held this position until 1945 when he retired on the amalgamation of the company with British Insulated Cables, Limited, to form the present British Insulated Callender's Cables, Limited. He was a director of a number of electricity-supply companies before their nationalization and for many years was on the Council of the Chartered Institute of Secretaries and later became its President.

Mr. MATTHEW HENRY WHITTAKER, of Street Lane, Roundhay, Leeds, who with his son, Mr. Harold Whittaker, founded in 1920, the business of M. H. Whittaker & Son, composing machine engineers, School Close Mills, Neville Street, Leeds, died in a Leeds nursing home on January 1 at the age of 85. He was a leading expert in printing machinery and invented the method of two-line letter setting on the Linotype machine, the stick attachment and the standardized spaceband. When he was apprenticed as a young man to a Manchester engineering concern he had erected the first Linotype machine to be brought into England.

DURING a visit to the company's overseas agents, Mr. ROBERT OSLER HERFORD, a director of Renold Chains, Limited, Manchester, died in Buenos Aires on January 2 at the age of 66. A nephew of the founder, he joined the original company, Hans Renold, Limited, in 1909 as a graduate apprentice. He became a director in 1917 and as works director was given charge of the production side of the business two years later. In 1930, the Renold & Coventry Chain Company, Limited, came into being with the addition of the Coventry Chain Company and Bramoton Bros., Limited, to the business, a merger which doubled the number of employees. Mr. Herford was made director responsible for the three concerns. In 1944 he became managing director of the merged company and retired from the position in 1953. He retained his seat on the board, however.

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WE HAVE BEEN ASKED to insert the following:—The directors of Henry Wallwork & Company, Limited, sincerely thank all friends for their kind expressions of sympathy and letters of condolence, received since the sudden death of Mr. G. B. Wallwork, a former managing director of the company.

# Company News

MORGAN CRUCIBLE COMPANY, LIMITED—The directors have declared a 6 per cent. interim dividend on account of the year ending March 31, 1955, which compares with a 3¾ per cent. interim for many years previously.

CROFTS ENGINEERS (HOLDINGS), LIMITED—The company has bought the whole of the share capital of Carter Gears, Limited, Bradford, which will be carried on as a wholly-owned subsidiary under the chairmanship of Sir Arthur Croft.

THOMPSON & SOUTHWICK, LIMITED, engineers, iron and non-ferrous founders, etc., of Tamworth (Staffs)—For the year to August 31 an ordinary dividend of 17½ per cent. has been declared, against 15 per cent. for 1952-53.

ANTI-ATTRITION METAL COMPANY, LIMITED—A further sharp fall in the profits from £69,301, in 1952-53, to £34,613, before tax of £15,410 (£45,439) is shown in the preliminary statement for the year to July 31, 1954. A dividend of 5 per cent., less tax, is recommended on the £400,000 one-class capital, compared with 12½ per cent., including a bonus of 2½ per cent., for each of the two preceding years.

ALLEN WEST & COMPANY, LIMITED, electric control and switchgear manufacturers, of Brighton—The directors are applying to the Capital Issues Committee for permission to increase the authorized capital from £1,250,000 to £2,000,000 and for permission to make a scrip issue by capitalization of reserves on the basis of one new ordinary share of 5s. for every two 5s. stock units held.

GLACIER METAL COMPANY, LIMITED—The issue of 520,408 5s. ordinary shares at 7s. 6d. per share has been accepted on provisional allotment letters to the extent of 500,309 shares. Applications for excess shares totalled over 290,000 shares. After providing shares for employees as laid down in the terms of the issue, the remaining shares have been allotted by ballot as follows: Up to 25 shares, in full; 26 to 250, 25; over 250, 50.

RAILWAY & GENERAL ENGINEERING COMPANY, LIMITED—The company reports that for the first half of the current financial year to March 31 next, the turnover and profit are substantially higher as compared with the previous year. An interim dividend on the ordinary capital of 10 per cent. payable on January 11 is therefore declared, against nil. The first and final of 12½ per cent. for 1953-54 repeated the previous year's rate.

DELTA METAL COMPANY, LIMITED—The directors announce a one-for-two scrip issue to holders at December 15. They state their intention to recommend a final distribution for the current year of 10 per cent., free of tax, on the capital as increased. In view of the acquisition of Earle, Bourne & Company, Limited, and Copper & Alloys, Limited, and the need for consolidating these companies' figures, publication of the accounts will be deferred until towards the end of March, and the annual meeting until the middle of April.

JOHN HOLROYD & COMPANY, LIMITED, machine-tool makers, of Rochdale—The directors recommend a first and final dividend on the "A" and "B" ordinary shares of 10 per cent., on the increased capital of £1,000,000, for the year ended September 30. For the previous year a dividend of 15 per cent. was paid on the old capital of £500,000. Last July the capital was doubled by a one-for-one scrip issue in "B" ordinary shares, the former ordinary being redesignated "A" ordinary. The 10 per cent. now recommended is thus effectively an increase from 7½ per cent.

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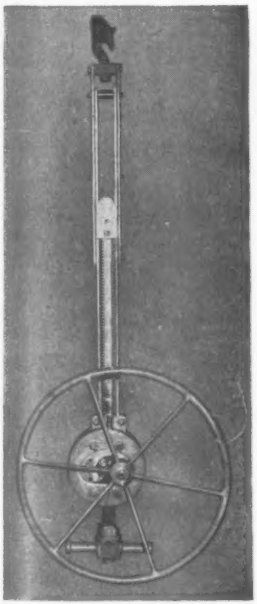

# 'ARON' FOUNDRY EQUIPMENT

## "RUTLAND"

### GEARED RACKING HOIST

The 'RUTLAND' Hoist is intended for a safe working load of 15 cwt., tested to 20 cwt.
High efficiency, machine cut, spur gears, operated by a large diameter hand wheel, are totally enclosed within the Gear Box, and the spindles work in precision ball bearings.
A one-way automatic brake is fitted which allows free rotation when lifting but creates a proportional resistance to the load when lowering.
Suspension is from a rotary type hook, whilst the bottom of the Rack is suitably arranged to carry the yoke of the ladle, or sling when conveying Mould Box parts.

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## Industrial Output Up

Industrial production established a new record in November last. It is estimated that the index for all industries was 136-137 (1948 = 100), compared with 135 in October—the previous high level—and 133 in November, 1953. The December index will probably prove to be eight or nine points below that for November because of the Christmas holiday, and this would bring the average figure for 1954 to 127, a rise of 5.2 per cent. on 1953.

Steel output during 1954 was up by 5 per cent. on 1953, while the engineering and shipbuilding group showed an advance of about 6 per cent. One of the few groups which showed no important movement during the year was coal mining.

During the first nine months of 1954 approval was given for the construction of 50,200,000 sq. ft. of factory space, compared with 27,300,000 sq. ft. in the same period of 1953. Orders for machine tools rose sharply throughout 1954: in the third quarter of the year they were no less than 62 per cent. greater than in the same period of 1953.

The wage index rose by one point during November. Taking June, 1947, as 100, the weekly wage index at the end of November stood at 144. In the first 11 months of last year the weekly wage bill increased by £3,370,000, compared with a rise of £2,250,000 in the corresponding period of 1953.

Some 304,000 working days, involving 48,500 men, were lost through industrial disputes during November. This was nearly three times as high as in November, 1953. About 50,000 working days were lost through minor disputes in the coal industry. In the first 11 months of last year 2,390,000 working days were lost through disputes, compared with 1,050,000 days in the corresponding period of 1953.

## Increases of Capital

JOHN SHAND (FOUNDRIES), LIMITED, Cardiff, increased by £9,500, in £1 ordinary shares, beyond the registered capital of £500.

MAXIM SILENCERS, LIMITED, ironfounders, etc., of Bristol, increased by £39,900, in £1 ordinary shares, beyond the registered capital of £100.

JAMES HOGG & SONS (NORTH SHIELDS), LIMITED, brass and metal founders, etc., increased by £30,000, in £1 ordinary shares, beyond the registered capital of £20,000.

GEORGE H. ALEXANDER MACHINERY, LIMITED, Birmingham, increased by £250,000, in 840,000 ordinary shares of 5s. and 40,000 unclassified shares of £1, beyond the registered capital of £100,000.

MODERN FOUNDRIES, LIMITED, of Halifax, increased by £40,000, in £1 ordinary shares, beyond the registered capital of £10,000. At August 20, 1954, William Asquith, Limited, held a majority of the issued shares.

SMITH PATTERSON COMPANY, LIMITED (formerly Smith Patterson (Blaydon) Company, Limited), iron and brass founders, etc., of London, N.W.1, increased by £49,9900, in £1 ordinary shares, beyond the registered capital of £100. On July 1, 1954, Vigilant Investments, Limited, was allotted 49,900 shares.

JOHN SUMMERS & SONS, LIMITED, increased by £8,520,000, in 1,000,000 5½ per cent. non-redeemable cumulative preference, 2,520,000 ordinary, and 5,000,000 unclassified shares, all of £1 each, beyond the registered capital of £9,480,000.

BUELL (1952), LIMITED, manufacturers of pulverizing and dust-collecting machinery, etc., of Sheffield, increased by £99,900, in £1 shares, beyond the registered capital of £100. The above increase is for the purpose of acquiring the undertaking of the Buell Combustion Company, Limited (in voluntary liquidation). At July 15, 1954, Edgar Allen & Company, Limited, held a majority of the issued shares.

ENAMELLED METAL PRODUCTS CORPORATION (1933), LIMITED, London, S.W.1, increased by £50,000, in £1 ordinary shares, beyond the registered capital of £75,000. At April 22, 1954, 50,000 preference and 25,000 ordinary shares had been issued, of which the Pfaudler Company, Rochester, New York, held 50,000 preference and 12,500 ordinary shares, and Henry Balfour & Company, Limited, Leven (Fife), held 12,500 ordinary shares.

## Contracts Open

*The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade, Export Services Branch, Room 801, Lacon House, Theobalds Road, London, W.C.1 (telephone CHAncery 4411, ext. 738 or 771), unless otherwise stated.*

BATTERSEA, January 14—Iron castings for the 12 months from April 1, 1955, for the Borough Council. The Town Hall, Lavender Hill, London, S.W.11.

MANSFIELD (NOTTS), January 31—Iron castings, comprising manhole and gully fittings, for the year ending March 31, 1956, for the Borough Council. The Borough Engineer and Surveyor, Carr Bank, Mansfield. (Reference No. 5.)

SOUTH AFRICA, January 20—Primers, magnesium alloy and ammonium dichromate, for the Union Tender and Supplies Board. (ESB/29453/54.)

WINCHESTER—Supply of cast-iron manhole covers and gratings and cast-iron pipes for the year ending March 31, 1956, for Hampshire County Council. Mr. A. C. Hughes, county surveyor, The Castle, Winchester.

LONDON, W.5, January 22—Supply of iron castings, lamp columns, and ventilating columns for the year commencing April 1, 1955, for Ealing Borough Council. The Borough Engineer and Surveyor, Town Hall, Ealing, W.5.

PRESTWICH (LANCS), January 29—Cast-iron manhole covers and frames and gully grates and frames for the 12 months ending March 31, 1956, for the Borough Council. The Borough Engineer, Town Hall, Prestwich.

TRURO, January 29—Cast-iron gully gratings, frames and weirs, stone crusher jaws, and drill steel, for the year ending March 31, 1955, for Cornwall County Council. The County Surveyor, County Hall, Truro.

## Recent Wills

HERRING, STEPHEN, former vice-president of Lamson Engineering Company, Limited, London, N.W.10, and a director of other companies ... ... ... £143,047

HUGHES, S. W., chairman and managing director of H. M. Hobson Limited, manufacturers of aircraft engine components, of Wolverhampton ... ... £37,906

PUTNAM, S. A., former joint managing director of John Lysaght, Limited, iron and steel makers, of Bristol, who was High Sheriff of Monmouthshire in 1947 ... ... ... ... ... ... £165,395

WOODFIELD, F. W., manager of the Manchester office of Babcock & Wilcox, Limited ... ... ... ... £11,278

HERRING, E. A., a director of John Lynn & Company, Limited, engineers and ironfounders, of Sunderland ... ... ... ... ... ... £17,067

SHEARDOWN, H. E., managing director of Charles D. Holmes & Company, Limited, gas and chemical engineers, of Hull, chairman of Cook, Welton & Gemmell, Limited, shipbuilders, of Beverley (Yorks), and of Humber Brass & Copper Works Company, Limited, who was associated with other companies and was a member of Lloyd's Register of Shipping Committee of Management and Technical Committee ... ... ... ... ... £61,591

GREEN, F. W., a director of E. Green & Son, Limited, fuel economizer manufacturers, of Wakefield (Yorks) ... ... ... ... ... £6,691

BOULTON, Dr. W. S., formerly Professor of Geology in the University of Birmingham ... ... ... £37,046

PARKER, L. P., formerly motive power superintendent of the Eastern Region of British Railways ... ... £12,602

HOLMES, PERCY, a partner in P. & F. Holmes, pump manufacturers, etc., of Laycock, Keighley (Yorks) £4,633

## Industrial Radiography

The Industrial Sales Division of Kodak, Limited, has organized an exhibition of materials and equipment for industrial radiography. It was staged in London at Kodak House, Kingsway, on January 7; will appear in Birmingham at the Imperial Hotel on January 28; in Leeds at the Queens Hotel on March 16; in Cardiff at the Grand Hotel on March 31; in Manchester at the Grand Hotel on April 27; in Glasgow at the Grand Hotel on May 12; in Newcastle-upon-Tyne at the Royal Station Hotel on May 19; and in Bristol at the Grand Hotel on May 27. The exhibitions will be open from 10 a.m. to 7 p.m.

**FOUNDRY FUMES???**

Though corebinder developments have not yet reached the stage where it is possible to guarantee a complete absence of unpleasant casting odours, B.I.P.'s latest synthetic resin corebinder—Beetle W42—represents a very considerable advance in this direction. Developed with the Garrett Report in mind, it combines all the advantages of Beetle W20 with a reduction in casting odour that will be appreciated by foundrymen.

***use* BEETLE RESIN W42* *for reduced casting odour***

B·I·P GROUP

Write for technical information to British Industrial Plastics Limited,
Tat Bank House, Oldbury, Nr. Birmingham. London Office: 1 Argyll Street, W.1
*'Beetle' is a trade mark registered in Great Britain and in most countries of the World.*

**Patent Application 32896/58*

# Raw Material Markets

## Iron and Steel

Satisfactory trading conditions are reported by most sections of the foundry industry. In addition to the work in hand, a large number of inquiries are circulating for castings for both home and export needs, and there will be little difficulty in acquiring fresh business to replace completed orders.

The engineering and speciality foundries are well placed for business, and further increasing demand for castings is indicated. The jobbing foundries also are busy and a continued improvement in trade is reported by many of the light and textile foundries, although demands are not yet sufficient to warrant capacity production.

In some instances shortage of labour is a drawback, but for most foundries the chief cause for anxiety is the scarcity of pig-iron. The low- and medium-phosphorus irons called for by the engineering and speciality foundries are very scarce in some areas, and hematite is also difficult to obtain, particularly in the higher silicon ranges. The immediate future holds out little hope of an improvement in the supply of the low- and medium-phosphorus irons, but an expansion in hematite production is likely as new plants are brought into commission. The supply of high-phosphorus iron for the light, jobbing, and textile foundries has been scanty during the last few weeks, but improved outputs are now expected to be obtained by producers of this grade.

Record outputs of pig-iron have been obtained, but supplies are still below the needs of consumers. The steelworks, whose requirements of basic iron are on an expanding scale, will benefit by increased outputs from fresh units which will be blown in during the year.

Arisings of the heavier and better grades of cast-iron scrap are becoming more scarce, particularly in some areas. Foundry coke is generally adequate for current needs, and there is no difficulty in obtaining sufficient supplies of ganister, limestone, and firebricks.

The steel re-rollers have plenty of work, but the difficulty in obtaining steel semis is daily becoming more acute. The steelworks' light and heavy mills are equally busy, and there is a continued demand for sheets.

## Non-ferrous Metals

Fairly active conditions prevailed on the London market last week. Initially the trend was firm, although tin was somewhat hesitant; but on Thursday, following a severe break on the American stock markets, sentiment changed and there was a general setback. The shake-out in Wall Street was severe, but a steadier tone supervened towards the end of the week and the Metal Exchange rallied. Operators were also encouraged by the announcement of the rail settlement in the U.K.

A strike has been in progress in Northern Rhodesia, but during the week there was a drift back to work and by the weekend conditions had much improved at the Roan Antelope mine, where output on a reduced scale had been kept going, and at Mufulira. Should the trouble be resolved quickly it is hoped that the interference with shipments will be kept to a minimum, but some delay is probably inevitable and this is particularly unfortunate in view of the fact that we have hardly had time to recover from the adverse effects of the dock strike, which led to so much dislocation of shipping schedules.

Consumption of all the non-ferrous metals in this country is good, copper being in the forefront, in spite of the high price. Fabricators of brass and copper semis, however, are badly placed for export business as the sterling price is by far the dearest in the world, at which much dissatisfaction is continually expressed by consumers.

In London last week cash copper fell at one time to £296 or even lower, but recovered to close at £300, which showed a gain of £9 on the previous Friday. In the three months position, where most of the business was done, the gain was £4 15s., the backwardation at the close of trading being nearly £23, a situation which makes hedging quite out of the question.

Tin lost ground rather seriously, for at the close cash was £13 10s. down and three months £13 lower. Stocks in L.M.E. warehouses have increased to a point where a contango is inevitable. Zinc gained 15s. in both positions and if the rise continues the American quotation may go up. Lead was down £3 10s. for prompt, but only 10s. forward, and the backwardation came in to 15s.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* January 6, £297 to £298; January 7, £296 to £297; January 10, £305 10s. to £307 10s.; January 11, £302 10s. to £305; January 12, £289 to £290.

*Three Months:* January 6, £279 to £280; January 7, £275 to £276; January 10, £282 10s. to £283; January 11, £280 to £280 10s.; January 12, £271 to £272.

TIN, Standard—*Cash:* January 6, £684 to £685; January 7, £679 to £680; January 10, £681 to £682; January 11, £680 to £681; January 12, £688 to £689.

*Three Months:* January 6, £684 to £685; January 7, £682 10s. to £683; January 10, £683 10s. to £684; January 11, £682 to £683; January 12, £688 10s. to £689.

ZINC—*First half January:* January 6, £84 5s. to £84 10s.; January 7, £84 5s. to £84 10s.; January 10, £84 15s. to £85; January 11, £85 5s. to £85 10s.; January 12, £85 to £85 10s.

*First half April:* January 6, £83 to £83 5s.; January 7, £83 to £83 5s.; January 10, £83 10s. to £83 15s.; January 11, £83 15s. to £84; January 12, £83 15s. to £84.

LEAD—*First half January:* January 6, £104 15s. to £105; January 7, £104 5s. to £104 10s.; January 10, £103 10s. to £103 15s.; January 11, £103 15s. to £104; January 12, £103 17s. 6d. to £104.

*First half April:* January 6, £103 15s. to £104; January 7, £103 10s. to £103 15s.; January 10, £103 10s. to £103 15s.; January 11, £103 15s. to £104; January 12, £103 17s. 6d. to £104 2s. 6d.

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## Iron and Steel Import Duties

After consultation with the Iron and Steel Board about the supply position, the Government has decided to make a new Order affecting the temporary suspension of import duties on iron and steel. The Order prolongs the temporary suspension of import duty on cold-rolled steel sheets of a value of less than £80 per ton until March 18, 1956, and suspends until September 18, 1955, the import duties on a wide range of iron and steel products. The duties on some of these had already been suspended until March 18, 1955.

The new Order—the Import Duties (Exemptions) (No. 1) Order, 1955 (SI.33)—comes into operation tomorrow (Friday). It replaces the Import Duties (Exemptions) (No. 6) Order, 1954.

SUPINEX "R" IN USE—

*Illustration of Binnacle casting in DTD 165 alloy by courtesy of Gascoignes Non-Ferrous Foundries Ltd., Slough.*

**SUPINEX "R"**
**CORE BINDER**

**AN ENTIRELY NEW TYPE OF BINDER, STARTLING IN ITS PERFORMANCE . . .**

- ★ **EXCEPTIONAL "KNOCK-OUT" PROPERTIES**
- ★ **FUMES AND GASES GREATLY REDUCED**
- ★ **GREEN AND DRY STRENGTH PROVIDED FOR**
- ★ **LOW PRICE REDUCING YOUR COST PER TON OF CORE SAND**

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**Free working samples gladly supplied on request.**

# Current Prices of Iron, Steel, and Non-ferrous Metals

*(Delivered unless otherwise stated)*

January 12, 1955

## PIG-IRON

**Foundry Iron.**—No. 3 IRON, CLASS 2:—Middlesbrough, £15 12s. 0d.; Birmingham, £15 5s. 3d.

**Low-phosphorus Iron.**—Over 0.10 to 0.75 per cent. P, £17 13s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £18 9s. 3d.

**Scotch Iron.**—No. 3 foundry, £18 2s. 3d., d/d Grangemouth.

**Cylinder and Refined Irons.**—North Zone, £20 4s. 0d.; South Zone, £20 6s. 6d.

**Refined Malleable.**—P, 0.10 per cent. max.—North Zone, £21 1s. 6d.; South Zone, £21 4s. 0d.

**Hematite.**—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £18 2s. 6d.; Scotland (Scotch iron), £18 9s. 0d.; Sheffield, £19 7s. 6d.; Birmingham, £19 14s. 6d.; Wales (Welsh iron), £18 9s. 0d.

**Basic Pig-iron.**—£15 15s. 6d. all districts.

## FERRO-ALLOYS

*(Per ton unless otherwise stated, delivered)*

**Ferro-silicon** (6-ton lots).—40/55 per cent., £40 15s. 0d., basis 45 per cent. Si, scale 15s. per unit; 70/84 per cent., £63 0s. 0d., basis 75 per cent. Si, scale 16s. per unit.

**Ferro-vanadium.**—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

**Ferro-molybdenum.**—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

**Ferro-titanium.**—20/25 per cent., carbon-free, £185 0s. 0d. to £195 0s. 0d. per ton; 38/40 per cent., £251 0s. 0d. to £270 0s. 0d. per ton.

**Ferro-tungsten.**—80/85 per cent., 14s. 3d. per lb. of W.

**Tungsten Metal Powder.**—98/99 per cent., 17s. 3d. per lb. of W.

**Ferro-chrome** (6-10 ton lots).—4/6 per cent. C, £75 0s. 0d. to £80 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £74 0s. 0d. to £76 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C,* 1s. 7½d. per lb. Cr; 1 per cent. C,* 1s. 8d. per lb. Cr; 0.15 per cent. C,* 1s. 9½d. per lb. Cr; 0.10 per cent. C,* 1s. 9¾d. per lb. Cr; 0.06 per cent. C,* 1s. 10d. per lb. Cr.

**Metallic Chromium.**—98/99 per cent., 6s. 6½d. to 7s. 1d. per lb.

**Metallic Manganese.**—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £255 0s. 0d. to £262 0s. 0d. per ton.

**Ferro-columbium.**—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

**Ferro-manganese** (home).—78 per cent., £54 15s. 0d.

## SEMI-FINISHED STEEL

**Re-rolling Billets, Blooms, and Slabs.**—BASIC: Soft, u.t., £25 5s. 0d.; tested, 0.08 to 0.25 per cent. C, £26 5s. 0d.; hard (0.41 to 0.60 per cent. C), £27 10s. 0d.; silico-manganese, £34 10s. 0d.; free-cutting, £29 6s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 17s. 0d.; silico-manganese, £34 10s. 0d.

* Average 68-70 per cent. Cr.

**Billets, Blooms, and Slabs for Forging and Stamping.**—Basic, soft, up to 0.25 per cent. C, £29 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 15s. 0d.

## FINISHED STEEL

**Heavy Plates and Sections.**—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £33 11s. 6d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

**Small Bars, Sheets, etc.**—Rounds and squares, under 3 in., untested, £31 19s. 6d.; flats, 5 in. wide and under, £31 19s. 6d.; hoop and strip, £33 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £34 5s. 0d.; black sheets (hand mill), 17/20 g., £43 13s. 6d.; galvanized corrugated sheets, 24 g., £54 10s. 0d.

**Alloy Steel Bars.**—1 in. dia. and up: Nickel, £54 7s. 9d.; nickel-chrome, £76 7s. 9d.; nickel-chrome-molybdenum, £86 8s. 6d.

## NON-FERROUS METALS

**Copper.**—Cash, £289 0s. 0d. to £290 0s. 0d.; three months, £271 0s. 0d. to £272 0s. 0d.; settlement, £290 0s. 0d.

**Copper Tubes, etc.**—Solid-drawn tubes, 34⅜d. per lb.; wire, 333s. 9d. per cwt. basis; 20 s.w.g., 365s. 0d. per cwt.

**Tin.**—Cash, £688 0s. 0d. to £689 0s. 0d.; three months, £688 10s. 0d. to £689 0s. 0d.; settlement, £689 0s. 0d.

**Zinc.**—First half January, £85 0s. 0d. to £85 10s. 0d.; first half April, £83 15s. 0d. to £84 0s. 0d.

**Zinc Sheets, etc.**—Sheets, 15 g. and thicker, all English destinations, £115 5s. 0d.; rolled zinc (boiler plates), all English destinations, £113 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £96 0s. 0d.

**Lead (Refined Pig).**—First half January, £103 17s. 6d. to £104 0s. 0d.; first half April, £103 17s. 6d. to £104 2s. 6d.

**Brass Tubes, etc.**—Solid-drawn tubes, 27½d. per lb.; rods, drawn, 36⅞d.; sheets to 10 w.g., 299s. 6d. per cwt.; wire, 34⅝d.; rolled metal, 285s. 9d. per cwt.

**Brass (Brazing).**—BS1400, B3 (65/35), £194; B6 (85/15), £260; BS249, £204.

**Brass (High Tensile).**—BS1400, HTB1 (30 tons), £236; HTB2 (30 tons), £236; HTB3 (48 tons), £253.

**Gunmetal.**—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £248; LG3 (86/7/5/2), £258; G1 (88/10/2/½), £323; (88/10/2/1), £313.

**Phosphor Bronze.**—BS1400, PB1 (AID released), £340 per ton.

**Phosphor Bronze Strip, etc.**—Strip, 419s. 3d. per cwt.; sheets to 10 w.g., 441s. 9d. per cwt.; wire, 51⅝d. per lb.; rods, 45½d.; tubes, 43½d.; chill cast bars: solids 45d., cored 46d. (CHARLES CLIFFORD, LIMITED.)

**Nickel Silver, etc.**—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 7½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 0¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 11¾d. All prices are net.

**Other Metals.**—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £109 0s. 0d. £110 0s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £163 0s. 0d.; aluminium bronze (BS1400), AB1, £295; AB2, £310. Solder, brazing, BS1845, 2s. 4d. lb.; granulated, 2s. 7d. lb.